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North Carolina Department of Transportation
Division of Highways
Statewide Planning Branch

THOROUGHFARE PLAN FOR THE TOWN OF WAYNESVILLE

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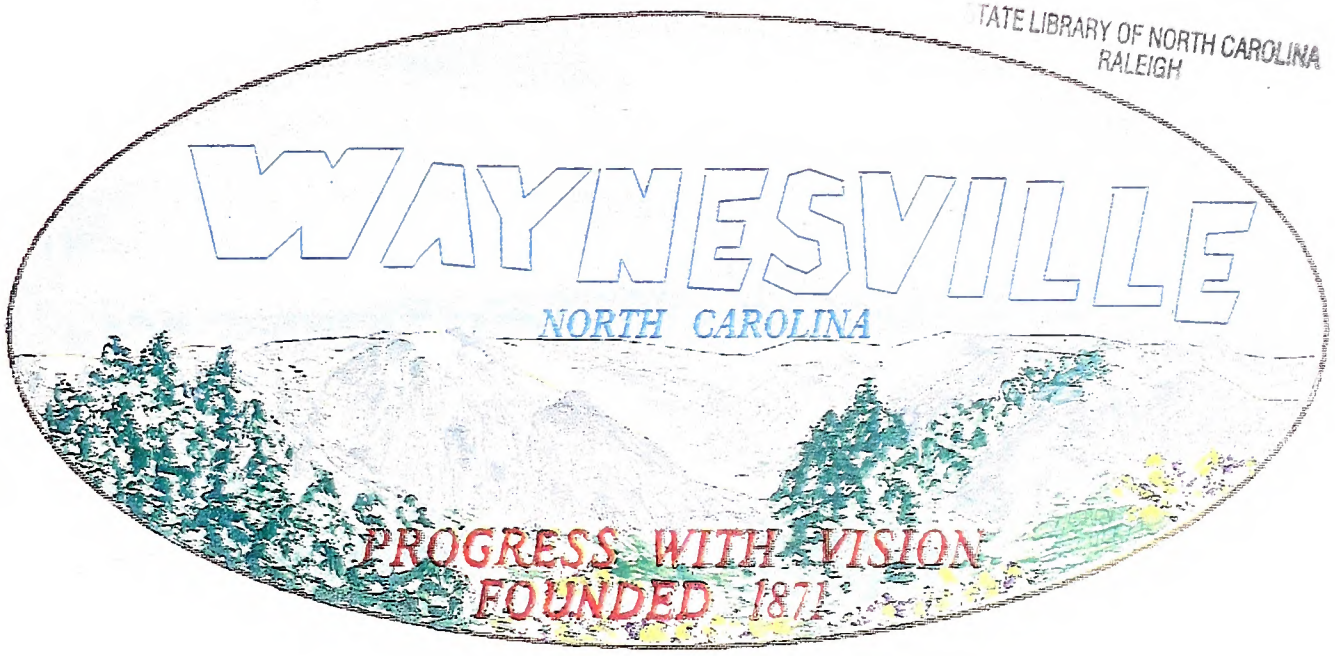

1996

THOROUGHFARE PLAN
FOR
THE TOWN OF WAYNESVILLE, NORTH CAROLINA

Prepared by the:

Statewide Planning Branch
Division of Highways
N.C. Department of Transportation

In Cooperation with:

The Town of Waynesville
The Federal Highway Administration
U.S. Department of Transportation

October 3, 1996

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EXECUTIVE SUMMARY

This report presents a comprehensive transportation study of the Waynesville Planning Area. It includes an evaluation of the existing road network; design year (2020) traffic projections; identification of system deficiencies; and recommended improvements that comprise the Transportation Plan. Figure 2 (pg. 7) shows the adopted 1993 Waynesville Transportation Plan. The major recommendations are listed below:

1. Dellwood Road Extension - Extend Dellwood Road to Brown Avenue. Widen Dellwood Road to four lanes between Russ Avenue and Miller Street.

2. US 23 Business - Widen US 23 Business to four lanes between Allen's Creek Road (SR 1147) and Welch Street. Also widen US 23 Business to four and five lanes between Walnut Street and the US 19A/23/74 Bypass.

3. Riverbend Street & Brown Avenue - Implement a one-way pair incorporating Riverbend Street (two lanes westbound) and Brown Avenue (two lanes eastbound).

4. SR 1818 (Ratcliff Cove Road) - Widen to a minimum of eighteen feet to improve safety.

5. SR 1134 (Country Club Road) - Widen to a minimum of eighteen feet to improve safety.

Chapter II contains detailed descriptions for each of these improvements. Appendix A table 8 lists base year traffic counts, design year traffic projections, capacity estimates, and proposed cross sections for all major and minor thoroughfares in the Waynesville Planning Area.

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I. INTRODUCTION

Background

In May of 1992 the Towns of Waynesville and Hazelwood officially requested that the NCDOT provide assistance in updating the 1980 Waynesville-Hazelwood Thoroughfare Plan. In August of 1992, representatives from the Statewide Planning Branch contacted the Towns and commenced the Waynesville-Hazelwood transportation study update.

Originally the Transportation Plan was going to include both the Towns of Waynesville and Hazelwood, but during the plan's development Hazelwood began the first steps in a process to be annexed by Waynesville. The Hazelwood Mayor stated that, due to her confidence in the impending Town merger, we should proceed with the plan as a Waynesville plan only. The planning area and recommendations did not change but the need for a separate public involvement/adoption process in Hazelwood was eliminated. The merger became effective July 1, 1995.

A recommended plan was developed and revised during several work sessions with the Waynesville Planning Board and the Waynesville Board of Aldermen. The Thoroughfare Plan was adopted unanimously by the Waynesville Board of Aldermen on May 10, 1994.

Organization

This report is divided into two main sections with supporting appendices. The first section (Chapters 2-4) discusses and prioritizes the recommendations and suggests methods for their implementation. The second section (Chapters 5 & 6) details the characteristics of the planning area that contribute to the need for transportation improvements. The appendices include discussions of thoroughfare planning principles, traffic forecasting techniques, and subdivision ordinances / design standards.

Purpose

The purpose of this report is to document the Adopted 1993 Thoroughfare Plan for the Waynesville Planning Area. The Thoroughfare Plan is a tool to be used by the local government to preserve corridors for future transportation projects and to obtain funding to implement recommended projects (see Chapter IV). In order for the plan to be of use, Waynesville must coordinate future land development with this plan.

The improvements recommended in this report are a direct result of traffic projections through the design year 2020. These projections are based on past growth trends and general land use forecasts furnished by the Town of Waynesville. It should be emphasized that the proposed thoroughfare plan is based on the anticipated growth in the planning area. It is possible that the actual growth patterns will differ somewhat from those logically anticipated. As a result, it may be necessary to accelerate or retard the implementation of some portions of the plan and/or make revisions which will accommodate unexpected changes in urban development.

GEOGRAPHIC LOCATION
FOR
WAYNESVILLE
NORTH CAROLINA

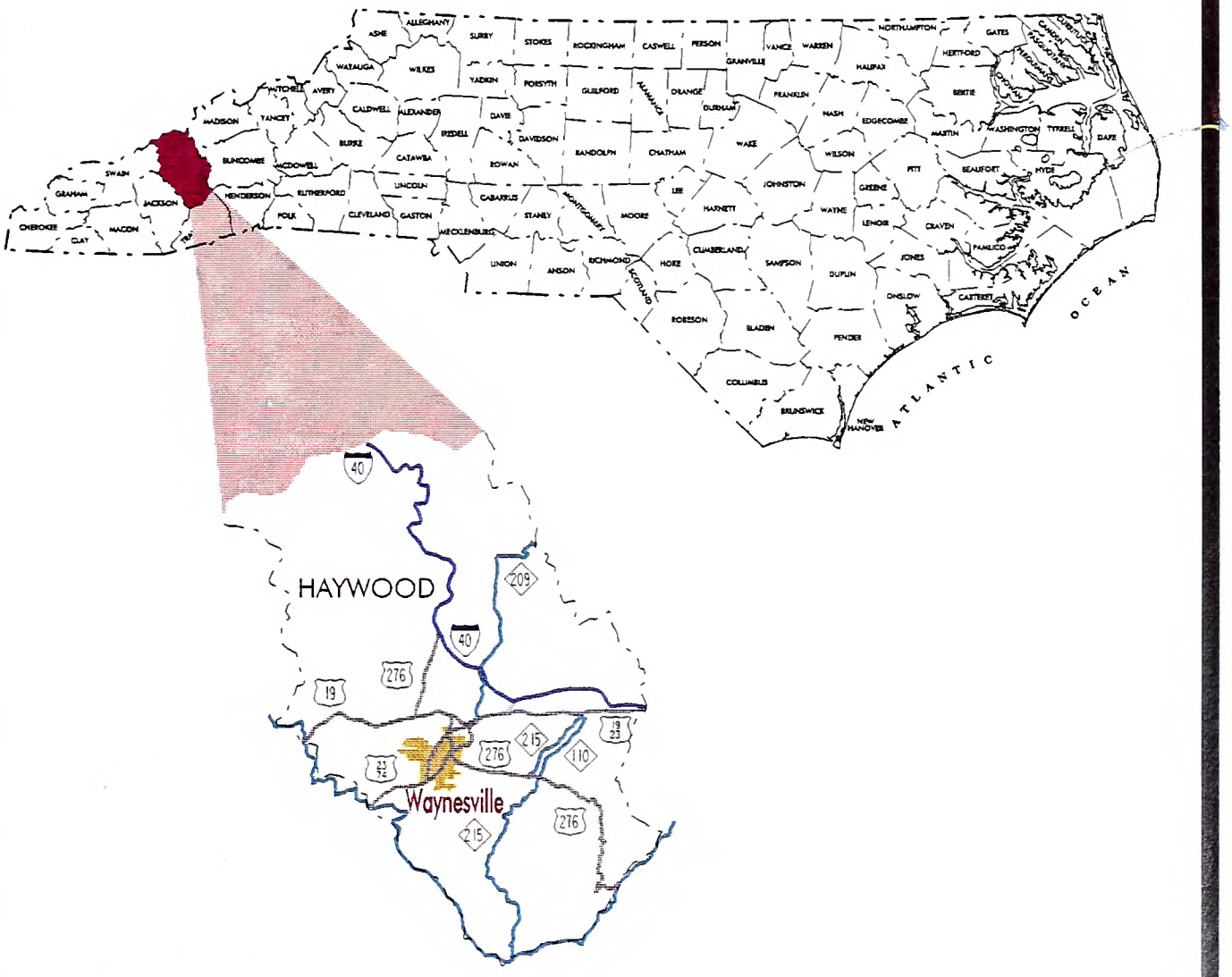


FIGURE 1

II. THOROUGHFARE PLAN

The following section provides a brief discussion of the classified roads in the Waynesville Thoroughfare Plan. Figure 2 shows the recommended plan. Specific details on physical and operational characteristics are given in Table 8.

Recommendations

Recommended improvements include:

Dellwood Road Extension - Dellwood Road should be extended, part on new location/ part utilizing existing Mill Street, to the intersection of Brown Avenue and Boyd Avenue. There are two recommended cross-sections for the Dellwood Road Extension: 1) four lanes from Russ Avenue to Miller Street; and 2) two lanes from Miller Street to Brown Avenue. The typical cross-section changes at Miller Street because at this point, westbound traffic will split among Miller Street, Dellwood Road Extension, and Smathers Street.

The Dellwood Road Extension also includes the recommended improvement of three intersections (see Figure 3). The existing Boyd Avenue-Brown Avenue, Miller Street-Commerce Street, and Depot Street-Mill Street-Love Lane intersections all have confusing geometrics including fifth legs and offset legs. Figure 3 demonstrates proposed improvements that include realignment, introduction of cul-de-sacs, and pavement removal.

Currently, two trains a day (approx. 3-5 days a week) use the Southern Railway through Waynesville. The Dellwood Road Extension will require two new at-grade crossings of this track. The intersection improvements listed above include the removal of two existing crossings for a net change of zero at-grade railroad crossings. Based on the traffic projected at the time of this study, a grade separation is not warranted at either railroad crossing (projected traffic x #trains per day is less than the required minimum). However, this will be reviewed if the project becomes funded.

US 23 Business - The implementation of the Dellwood Road Extension will relieve a portion of the traffic on US 23 Business. But, projected volumes will still approach and exceed capacity between Allen's Creek Road (SR 1147) and the US 19/23/74 Bypass east of the Waynesville City limits. The section of US 23 Business between the Bypass and the east city limit is currently programed (TIP R-2210) for widening to four- and five-lanes with curb and gutter (construction FY 2000). Due to projected traffic, additional widening to a four-lane curb and gutter section is recommended between Allen's Creek Road and Welch Street.

Riverbend Street/Brown Avenue One-Way Pair - Riverbend Street and Brown Avenue are currently parallel two-lane streets inside the Hazelwood City limits. Implementing a one-way pair (Riverbend Street southbound, Brown Avenue northbound) will not require additional widening or construction. Traffic heading northbound on the existing four lane section of Brown Avenue must currently merge from two-lanes to one-lane at the intersection of Riverbend Street and Brown Avenue. The implementation of this one-way pair will allow the continuation of two lanes northbound to Main Street in Hazelwood.

Ratcliff Cove Road (SR 1818) - This major thoroughfare is currently 4.9m (16 ft) wide. It should be widened to a minimum of 5.5m (18 ft) to attain acceptable safe standards.

Country Club Drive (SR 1134) - This minor thoroughfare is also currently 4.9m (16 ft) wide. It should be widened to a minimum of 5.5m (18 ft) to attain acceptable safe standards.

Major Thoroughfares

Existing major thoroughfares include:

US 19 - US 19 splits from the Bypass east of Waynesville and heads north. The existing cross-section is sufficient for the projected traffic.

US 19A/23/74 Bypass - This bypass is a four-lane freeway that carries through traffic between the east and west sides of the planning area. It connects with I-40 to Asheville which is roughly fifteen miles east of the planning area. The current facility is adequate to handle the projected traffic. No improvements are recommended.

NC 209 - This two-lane highway runs north from the bypass to the planning area boundary. The traffic volumes are not projected to approach capacity so no improvements are deemed necessary.

US 276 - This north-south route runs concurrently with Main Street in downtown Waynesville. It has two lanes throughout most of the planning area. There is a five-lane section between the Bypass and SR 1247 that carries significant volumes of traffic. The Town should carefully consider additional commercial development along this stretch and minimize the number of access points so that the need for additional signals is eliminated. The bridge carrying US 276 over the Southern Railroad currently has a sufficiency rating of 73. If in the future the rating falls below 50 (see Chapter VI pg. 25) and the bridge becomes programmed for replacement, a five-lane section is recommended. The five-lane width will allow a left-turn lane for southbound vehicles turning from US 276 to Walnut Street.

Allen's Creek Road (SR 1147) - No improvements are recommended for this two-lane major thoroughfare. The projected volumes do not approach the capacity.

Branner Avenue - Branner Avenue operates as a major thoroughfare in conjunction with Haywood Street. No improvements are recommended for this section of road.

Brown Avenue - Brown Avenue will become an important link in the thoroughfare system with the implementation of the Dellwood Road Extension. Although traffic volumes will increase, they will remain within the capacity. Therefore, no additional improvements are deemed necessary.

Hazelwood Avenue - Hazelwood Avenue connects US 23 Business, Brown Avenue, and the US 19A/23/74 Bypass. No improvements are recommended for this section of road.

Elysinia Road - This road connects East Main Street with the US 19A/23/74 Bypass. No improvements are recommended for this section of road.

Haywood Street - This street will continue to operate as a major thoroughfare in downtown Waynesville. No improvements are recommended for Haywood Street because the projected traffic is below the capacity.

Miller Street - Miller Street will carry traffic into the center of downtown and will be an important link in the thoroughfare system. It connects Haywood Street and the Dellwood Street Extension. The projected volumes are within capacity, so no improvements are recommended.

Sulphur Springs/Smathers Street - The projected traffic on this major thoroughfare is well below capacity. Therefore, no improvements are recommended for this section of road.

Minor Thoroughfares

Existing minor thoroughfares include:

SR 1812 - This road connects US 276 and SR 1818 which are both major thoroughfares. It is projected to continue to serve relatively low volumes of traffic. No additional improvements are recommended because SR 1812 currently meets a minimum safe width of 5.5m (18 ft).

WAYNESVILLE
HAZELWOOD
SMATHERS STREET
COUNTRY CLUB DRIVE
LEGEND
EXISTING
PROPOSED
MAJOR THOROUGHFARES
MINOR THOROUGHFARES
ADOPTED BY:
WAYNESVILLE:
STATEWIDE PLANNING BRANCH:
N. C. DEPT. OF TRANSPORTATION:
PUBLIC HEARING DATE:
THOROUGHFARE PLAN
WAYNESVILLE
OCTOBER 14, 1993

FIGURE 2

DELLWOOD RD

EXTENSION CONCEPT

WAYNESVILLE

NORTH CAROLINA

Not To Scale

FIGURE 3

III. CONSTRUCTION PRIORITIES

Construction priorities depend on the potential that proposed projects have to satisfy various objectives. Some of the most important objectives are **(1)** improvement of the State's arterial system; **(2)** cost effective improvement of the safety and level-of-service of all roads and highways on the State system; **(3)** encouragement of economic development; **(4)** preservation of the environment; and **(5)** fair and equitable allocation of project funding.

Table 1 summarizes each of the major projects based on its benefits (computed using the Benefits Matrix Model), its estimated right-of-way and construction cost, its probability of stimulating the local economy, and its effect on the environment. This table should be used to establish the priority of each project. Correct prioritization of the projects can result in the implementation of the most beneficial projects first.

Project Cost Estimates

Considerations used to obtain cost estimates for each of the thoroughfare plan projects include: the cross section (the number of lanes, lane widths, shoulders and right-of-way width); the estimated cost of land, residences, and businesses that would have to be bought during the right-of-way acquisition; and the structures required to cross streams, railroad tracks and other roads. Table 2 lists the cost elements for each of the projects.

Environmental Concerns

Evaluation of the environmental impacts of a project is one of the more difficult tasks. Environmental factors usually considered in highway project evaluation can be divided into three categories -- physical, social and/or cultural, and economic. Factors from all of these categories are utilized in the benefits analysis. The relative environmental impact of a project is measured by summing the positive and negative impacts. Table 3 contains the primary environmental factors considered in the project evaluation.

TABLE 1
BENEFITS EVALUATION

Project	Benefits (1000's)	Costs (1000's)	Length Km	Benefit Per Km	Econ. Benefit	Environ. Impact
Dellwood Rd Widening	8,258	1,480	1.09	7,570	+ 0.1	+ 0.2 - 0.1
US 23 Bus. Widening *	4,404	3,580	2.88	1,530	+ 0.2	+ 0.3
Dellwood Rd Extension	493	1,560	0.61	810	+ 0.1	+ 0.5

* The estimated benefits/impacts do not include the section already programed, TIP # R-2210.

TABLE 2
ELEMENTS FOR ESTIMATING PROJECT COSTS

Cost Element	Dellwood Extension	Dellwood Widening	US 23 Bus. Widening *
Cross Section: (see Fig. 9)	G&J	G	G
Right-of-Way:			
Farmland (acres)	0	0	0
Residences (#)	0	7	10
Businesses (#)	1	0	5
Structures:			
Bridges	1	0	0
Culverts	0	0	0
Estimated Project Cost (1000's)	1,560	1,480	3,580

* The estimated impacts/costs do not include the section already programed, TIP # R-2210.

TABLE 3
ENVIRONMENTAL CONSIDERATIONS

Physical Environment	Social and/or Cultural Environment	Economic Environment
Air Quality	Housing	Businesses
Water Resources	Neighborhoods	Employment
Wildlife	Noise	Economic Development
Vegetation	Education Facilities	Public Utilities
	Churches	Transportation Costs
	Park and Recreational Facilities	Capital Costs
	Public Health and Safety	Operation and Maintenance Costs
	National Defense	
	Aesthetics	

IV. IMPLEMENTATION

There are several methods through which a local government may implement a Thoroughfare Plan. Suggested methods for the projects in the Waynesville Thoroughfare Plan are listed below and summarized in Table 4. The remainder of this chapter describes the various methods.

Waynesville Thoroughfare Plan: Suggested Project Implementation

The following text lists each of the recommended projects, their estimated cost, and a recommended method of implementation. The project order is consistent with the priority given in Chapter III (based on benefits analysis). The recommendations of this chapter are summarized in Table 4 . For all projects, it is recommended that the Town use its local subdivision regulations and zoning ordinances in conjunction with the Thoroughfare Plan to preserve corridors and prevent encroachment of development that could prevent or increase the cost of construction.

1. Dellwood Road Widening - $ 1,480,000
   Due to the scope of this project, the best implementation method is to pursue getting this project programmed in the State TIP. It is advisable to include both the widening and extension (see #3 below) of Dellwood as one project in the TIP.

2. US 23 Business Widening - $ 3,580,000
   Due to the scope and estimated cost of this project, the best implementation method is through the TIP.

3. Dellwood Road Extension - $ 1,560,000
   The best method of implementation for this project is to combine it with the widening project (see #1 above) as one project and get it programmed in the TIP.

Implementation Methods

State-Municipal Adoption of the Thoroughfare Plan

Both the Town of Waynesville and the North Carolina Department of Transportation have responsibility for implementation of the Waynesville Thoroughfare Plan. Chapter 136, Article 3A, Section 136-66.2 of the North Carolina General Statutes provides that after development of a thoroughfare plan, the plan may be adopted by the governing body of the municipality and the Board of Transportation as the basis for future street and highway improvements. After mutual adoption, negotiations will begin to determine which of the existing and proposed thoroughfares will be a Department of Transportation responsibility and which will be a municipal responsibility. Facilities which are designated as State responsibility will be constructed and maintained by the Division of Highways; however, the municipality may share in the right-of-way cost. This share of costs will be determined at the time of construction.

In general, the State is responsible for those facilities which will be serving major volumes of through traffic and traffic from outside the area to major commercial, industrial, and institutional areas inside the municipality. Those facilities which will serve primarily internal traffic are to be a municipal responsibility.

After adoption of the thoroughfare plan, a municipality has the legal authority provided by the General Statutes of North Carolina to protect existing and proposed highway corridors through subdivision regulations and future street-line ordinances.

Subdivision Controls

Subdivision regulations require every subdivider to submit to the local planning commission a plan of his proposed subdivision and requires that the subdivision be constructed to certain standards. Through this process, it is possible to require the subdivision streets to conform to the Thoroughfare Plan and to reserve or protect necessary rights-of-way for projected roads and highways that are to become a part of the Thoroughfare Plan. The construction of subdivision streets to adequate standards would reduce maintenance costs and would facilitate the transfer of the streets to the State Highway System. Appendix E outlines the recommended design standards.

Roadway Corridor Official Map

North Carolina General Statutes 136-44.50 through 133-44.53 are collectively designated as the "Roadway Corridor Official Map Act." For cities contemplating the adoption of a Roadway Corridor Map, more commonly referred to as an official street map, there several things to consider prior to implementation. First and foremost, it should be recognized that an official street map places severe, but temporary, restrictions on private property rights. These restrictions are in the form of a prohibition, for a period of up to three years, for the issuance of building permits or subdivision of property lying within an official street map corridor. This authority should be used carefully and only in cases where less restrictive powers will be ineffective.

The Statute establishing the Official Street Map authority is fairly explicit in outlining the procedures to be followed and the types of projects to be considered. As required by the Statute, a project being considered for an Official Street Map must be programed in the State's Transportation Improvement Program (TIP) **or** included in a locally adopted capital improvement plan, in addition to appearing on the adopted street system plan. The Statute states that the capital improvement plan must be for a period of ten years or less, and must identify the estimated cost of acquisition and construction of the proposed project as well as the anticipated financing.

The Program and Policy Branch of the North Carolina Department of Transportation is responsible for facilitating the adoption of Official Street Maps. Cities considering Official

Street Map projects should contact this Branch for their "Guidelines for Municipalities Considering Adoption of Roadway Corridor Maps" at:

Program and Development Branch
NC Department of Transportation
P.O. Box 25201
Raleigh, NC 27611

Zoning

A zoning ordinance can be beneficial to thoroughfare planning in that planned locations of various land uses and planned densities of dwellings can be realized. This provides a degree of stability on which to make future traffic projections and to plan streets and highways.

Other benefits of a good zoning ordinance are: **(1)** the establishment of standards of development which will aid traffic operations on major thoroughfares, and **(2)** minimizing strip commercial development which creates traffic friction and increases the traffic accident potential.

Urban Renewal

Urban renewal is defined as the rehabilitation of downtown areas by demolishing, remodeling, or repairing existing structures in accordance with comprehensive plans. This process allows for corrections to basic problems in the street system layout and design.

To qualify for community development funds or discretionary funds for urban renewal, a city must first prepare a community development program. Urban areas compete throughout the State on the bases of demographic points which consider such conditions as percent of substandard housing, people per square feet of housing, dwelling unit age, etc. An effort can be made to ensure that community development and transportation plans are compatible.

Capital Improvements Program

One of the tools which makes it easier to build a planned thoroughfare system is a capital improvements program. This is a long range plan for the spending of money on street improvements, acquisition of right-of-way, and other capital improvements within the bounds of projected revenues. Municipal funds should be available for construction of street improvements which are a municipal responsibility, right-of-way cost sharing on facilities designated as Division of Highways responsibility, and advance purchase of right-of-way where such action is required.

The section of the capital improvements program which deals with the thoroughfare plan requires a fairly detailed knowledge of the costs of various projects. This program could be used to benefit any of the improvements listed in this plan.

Development Reviews

Driveway access to a State-maintained street or highway is reviewed by the District Engineer's office and by the Traffic Engineering Branch of the North Carolina Department of Transportation prior to access being allowed. Any development expected to generate large volumes (i.e. shopping centers, fast food restaurants, large industries, etc.) may be comprehensively studied by staff from the Traffic Engineering, Planning and Research, and Roadway Design Branches of NC DOT. If done at an early stage, it is often possible to significantly improve the development's accessibility at minimal expense. Since the municipality is the first point of contact for developers, it is important that the municipality advise them of this review requirement and cooperate in the review process.

Other Funding Sources

1. Assess user impact fees to fund transportation projects. These fees, called "facility fees" in the legislation, are to be based upon "reasonable and uniform considerations of capital costs to be incurred by the town as a result of new construction. The facility fee must bear a direct relationship to additional or expanded public capital costs of the community service facilities to be rendered for the inhabitants, occupants of the new construction, or those associated with the development process."

2. Enact a bond issue to fund street improvements.

3. Continue to work with NCDOT to have local projects included in the Transportation Improvement Program(TIP).

4. Consider the possibility of specific projects qualifying for federal demonstration project funds.

5. Adopt a collector street plan that would assess buyer or property owners for street improvement.

6. Charge a special assessment for utilities; for example, increase water and sewer bills to cover cost of street improvements.

TABLE 4

FUNDING SOURCES & METHODS RECOMMENDED FOR IMPLEMENTATION OF PROJECTS										
PROJECT	FUNDING SOURCES					METHODS OF IMPLEMENTATION				
	Local Funds	TIP Funds	Indust. Access	Small Urban	Secondary Roads	T-fare Plan	Subdiv. Ord.	Zoning Ord.	Future Street Lines	Development Review
Welch St Extension		X		X		X		X	X	X
Dellwood Rd Widening		X				X	X	X	X	X
US 23 Bus. Widening		X				X		X	X	X
Dellwood Rd Extension		X				X		X	X	X

V. EXISTING AND PROJECTED CONDITIONS

Factors Affecting Transportation

The objective of thoroughfare planning is to develop a transportation system which will enable people and goods to travel safely and economically. To determine the needs of an area, its population, land use, and traffic must be examined. It is important to understand and describe the type and volume of travel which takes place in the area, and also to clearly identify the goals and objectives to be met by the transportation plan.

In order to fulfill the objectives of an adequate twenty year thoroughfare plan, reliable forecasts of future travel patterns must be achieved. Such forecasts are possible only when the following major items are carefully analyzed: **(1)** historic and potential population changes; **2)** significant trends in the economy; **(3)** character and intensity of land development; and **(4)** ability of the existing transportation system to meet existing and future travel demand. Additional items that vary in influence include the effects of legal controls such as zoning ordinances and subdivision regulations, availability of public utilities and transportation facilities, and topographic and other physical features of the urban area.

Population Trends

The volume of traffic on any road is a direct result of the size and distribution of the area's population. For this study, population data was obtained from the Office of State Planning. This data included Haywood County projections through the year 2010 . The County growth rate between 1990 and 2010 was used to project design year (2020) values. The existing planning area population was computed by multiplying the number of dwelling units (DU) in the planning area by the persons per DU (see Appendix C). Although the County is predicted to experience a slight decrease in population, the trend in the planning area indicates a very slight increase during the design period.

TABLE 5

POPULATION TRENDS AND PROJECTIONS

YEAR	1970	1980	1990	2010	2020
Haywood Co.	41,710	46,495	46,942	45,697	45,086
Waynesville Township	6,488	6,765	6,758	---	8,868
Waynesville Planning Area	---	---	9,620	---	12,966

Economic Trends

The Waynesville economy has changed little since the development of the 1980 thoroughfare plan. The type and location of employment in the planning area has remained consistent. In Waynesville, highway retail establishments and other commercial employers are located primarily along US 276 and US 23 Business. Main Street is lined with shops that cater to the significant amount of tourists that visit during the Fall. Industrial employers are located on both the east and west ends of the planning area with access to US 23 Business. The commercial and industrial employers in Hazelwood are located along or have access to both US 23 Business and Main Street. It is projected that any increase in planning-area employment will primarily occur in the same locations where it now exists. Employment growth will therefore increase the burden on the major thoroughfares in the planning area.

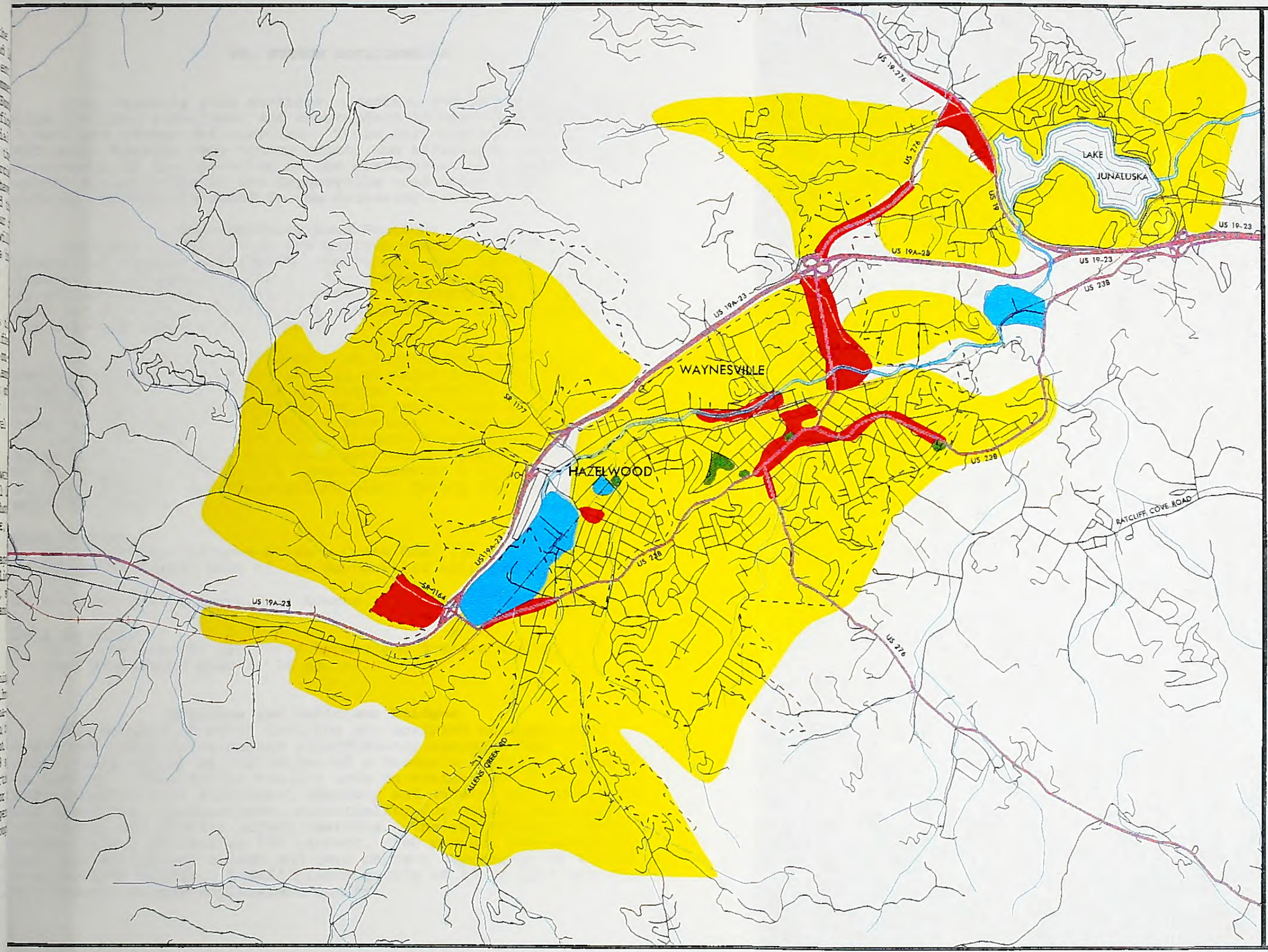
Land Use

The generation of traffic on a particular street is closely related to the adjacent land use. Attraction between different land uses varies with the intensity and spatial separation of the uses. As a result, for the purpose of transportation planning, it is necessary to designate land use by type. An analysis of the distribution of existing land uses serves as a basis for forecasting future land use needs and the resulting travel patterns.

For thoroughfare planning purposes, the land uses were grouped into four broad categories: **(1) Residential** - all land devoted to the housing of people, with the exception of hotels and motels; **(2) Commercial** - all land devoted to retail trade, including consumer and business services and offices; **(3) Industrial** - all land devoted to manufacturing, storage, warehousing, and transportation of products; and **(4) Public** - all land devoted to social, religious, educational, cultural, and political activities. The Waynesville Planning Area's land use is shown in Figure 4.

Existing Highway System

Currently, four highways serve the Waynesville planning area. The US 19-A/23 Bypass is a freeway that carries traffic through the planning area and connects I-40 and the North Carolina-Georgia border. US 276 is a north-south route that winds through the center of Waynesville. Significant commercial development lines this highway just south of the bypass (see Fig.4). US 19 splits north from the bypass and connects with US 276 in the northern section of the planning area. US 23 Business is the major route in the planning area for both internally and externally generated traffic. This highway runs concurrently with US 276 through the center of Waynesville.



EXISTING LAND USE

LEGEND:

- RESIDENTIAL
- COMMERCIAL
- INDUSTRIAL
- PUBLIC

WAYNESVILLE

AND VICINITY

FIGURE 4

VI. SYSTEM DEFICIENCIES

Over-capacity road sections, obsolete and deficient bridges, high accident locations, and substandard intersection geometry all constitute system deficiencies. These deficiencies must be addressed because they hinder safety and efficiency and can cause breakdowns in the operation of the transportation system. The system deficiencies in the Waynesville road network are categorized and addressed in the following text:

Over-Capacity Road Sections

Capacity is defined as the maximum number of vehicles, under prevailing roadway and traffic conditions, that have a reasonable expectation of passing over a given roadway section in one or both directions during a given time period. A comparison of capacity with actual traffic volumes is a good indicator of the adequacy of the existing major street network.

In an urban area, a street's ability to move traffic is generally controlled by the spacing of major intersections, the pavement width, and the type and number of traffic control devices. These characteristics can be manipulated to increase the capacity and improve the level of service. A more detailed discussion of capacity and level-of-service is presented in Appendix D. The Waynesville road sections projected to be near- or over-capacity (based on a level-of-service D without the implementation of the thoroughfare plan) during the design period are listed below:

Over Capacity

1. US 23 Business between Allen's Creek Road (SR 1147) and US 19A/23/74 Bypass east of the Waynesville city limits.

2. Dellwood Road between Russ Avenue (US 276) and Depot Street.

Near Capacity

3. US 276 between US 19A/23/74 bypass and Branner Avenue. (see discussion Chapter II pg. 4)

Obsolete and Deficient Bridges

All bridges in North Carolina are analyzed at least once every two years and assigned a sufficiency rating. The sufficiency rating is indicative of a bridge's ability to remain in service. This rating results from an evaluation of the following factors; structural adequacy and safety, serviceability and functional obsolescence, essentiality for public use, type structure, and traffic safety features. The sufficiency rating ranges from 0 percent to 100 percent. 100 percent represents an entirely sufficient bridge and zero percent represents an entirely insufficient bridge. A sufficiency rating of 50 or less qualifies for Federal Bridge Replacement funds.

Substandard bridges can be further classified into two categories: 1) structurally deficient; and 2) functionally obsolete. Structurally deficient bridges are in relatively poor condition or have insufficient load carrying capacity. Functionally obsolete bridges are narrow, have inadequate underclearances, have insufficient load carrying capacity, or are poorly aligned with the roadway and can no longer adequately serve today's traffic.

Table 6 is a list of substandard bridges located on routes included in the Thoroughfare Plan. Figure 5 shows the location of substandard bridges in the Waynesville planning area.

TABLE 6 SUBSTANDARD BRIDGES

KEY (see fig. 5)	**BRIDGE #**	**SUFFICIENCY RATING**
Structurally Deficient		
1.	94	16.5
Functionally Obsolete		
2.	54	77.9
3.	55	54.0
4.	155	70.8
5.	158	71.8
6.	186	76.3
7.	403	46.9

High Accident Locations

Accident records for January, 1988, through July, 1992, were studied for intersections in the Waynesville planning area. Typically, a location is flagged as having a high accident frequency if it has an average of five or more accidents per year. This number is used because the Manual on Uniform Traffic Control Devices (MUTCD) includes five or more annual accidents as a warrant to consider signalizing an intersection.

Table 7 lists the locations in the planning area with the highest accident frequency. The implementation of the eastern connector, in particular, will alleviate traffic on this corridor and should decrease the potential for high accident rates.

TABLE 7 HIGH ACCIDENT LOCATIONS

Key (fig. 5)	**Intersection**	**# Accidents** (1-88 to 7-92)
1	US 19 @ US 276	41
2	US 23 @ US 276	18
3	Dellwood Rd @ Russ Ave	21
4	Howell Mill Rd @ Russ Ave	23
5	Russ Ave @ Walnut St	19
6	Border St @ Russ Ave	16
7	Russ Ave @ Lee St	18

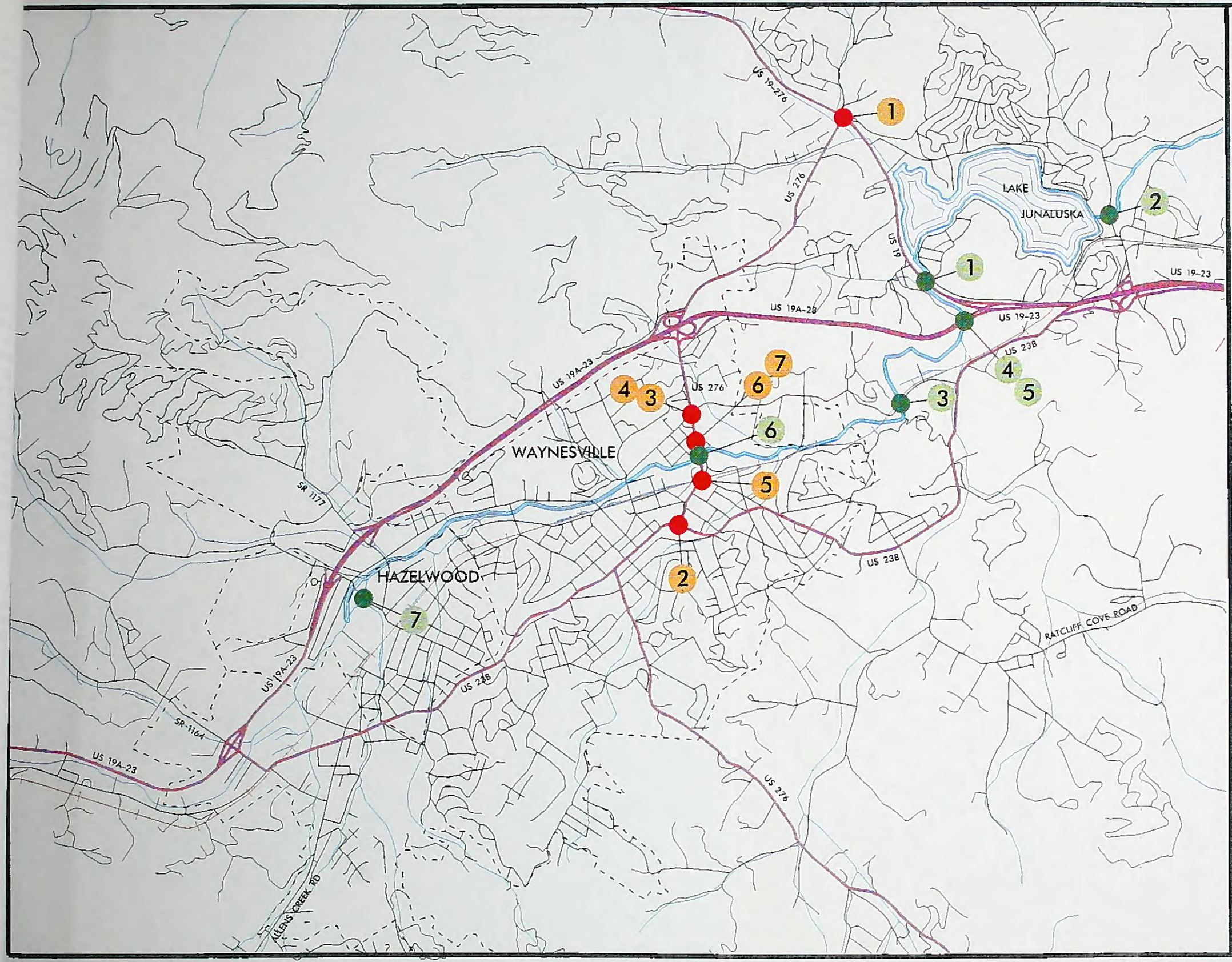
Intersection Geometry

Intersections should be aligned so that drivers can easily discern the actions of other drivers and perform the maneuvers necessary to pass through the intersection safely with a minimum of interference by other users (A Policy on Geometric Design of Highways and Streets 1990, AASHTO). Intersections with offset legs and/or more than four legs hinder safety and increase driver confusion. Where these conditions exist, the intersections can be improved by realignment. Improvement of the following intersections is recommended (see Chapter II pg. 3 and Figure 3 for more detail):

1. Brown Avenue at Boyd Avenue - This is currently a 4-leg offset intersection.

2. Miller Street at Commerce Street - This is currently a 5-leg offset intersection.

3. Dellwood Road at Depot Street - The major movement at this intersection is on Dellwood and Depot. Love Lane and Park Drive both intersect in the curve. The geometry of this intersection is unusual and contributes to increased driver confusion.



SUBSTANDARD BRIDGES AND HIGH ACCIDENT LOCATIONS

LEGEND:

SUBSTANDARD BRIDGE

HIGH ACCIDENT LOCATION

WAYNESVILLE AND VICINITY

FIGURE 5

APPENDICES

APPENDIX A

TYPICAL THOROUGHFARE CROSS SECTIONS

Cross section requirements for thoroughfares vary according to the desired capacity and level of service to be provided. Universal standards in the design of thoroughfares are not practical. Each street section must be individually analyzed and its cross section requirements determined on the basis of amount and type of projected traffic, existing capacity, desired level of service, and available right-of-way.

Typical cross section recommendations are shown in Figure 6. These cross sections are typical for facilities on new location and where right-of-way constraints are not critical. For widening projects and urban projects with limited right-of-way, special cross sections should be developed that meet the needs of the project.

Recommended typical cross sections for thoroughfares were derived on the basis of projected traffic, existing capacities, desirable levels of service, and available right-of-way. The recommended typical cross sections for the thoroughfares are given in Table 8 along with other pertinent information.

On all existing and proposed major thoroughfares delineated on the thoroughfare plan, adequate right-of-way should be protected or acquired for the ultimate cross sections. Ultimate desirable cross sections for each of the thoroughfares are listed in Table 8. Recommendations for "ultimate" cross sections are provided for (1) thoroughfares which may require widening after the current planning period; (2) for thoroughfares which are borderline adequate and accelerated traffic growth could render them deficient; and (3) for thoroughfares where an urban curb and gutter cross section may be locally desirable because of urban development or redevelopment.

Recommended design standards relating to maximum and minimum grades, minimum sight distances, maximum degree of curve and related super elevation, and other considerations for thoroughfares are given in Appendix E. This Appendix gives definitions and design standards recommended for inclusion in subdivision regulations.

Cross sections "A" and "L" is typical for controlled access freeways. The 14 m (46 ft) grassed median is the minimum desirable median width, but there could be some variation from this depending upon design considerations. Right-of-way requirements would typically vary upward from 70 m (228 ft) depending upon cut and fill requirements.

Cross section "B", seven lane curb and gutter, should not be used for new projects. When the conditions warrant six lanes, cross section "D" should be recommended. Cross section "B" should be used only in special situations such as when widening from a five lane section and right-of-way is limited. Even in these situations, consideration should be given to converting the center turn lane to a median so that cross section "D" is the final cross section.

Cross section "C", five lane curb and gutter, is typical for major thoroughfares where frequent left turns are anticipated as a result of abutting development or frequent street intersections.

Cross sections "D", "E", and "M" are used on major thoroughfares where left turns and intersecting streets are not as frequent. Left turns would be restricted to a few selected intersections. The 4.9 m (16 ft) median is the minimum recommended for an urban boulevard type cross section. In most instances, monolithic construction should be utilized due to greater cost effectiveness, ease and speed of placement, and reduced future maintenance requirements. In special cases, grassed or landscaped medians may be used in urban areas. However, these types of medians result in greatly increased maintenance costs and an increased danger to maintenance personnel. Non-monolithic medians should only be recommended when the above concerns are addressed.

Cross section "F" is recommended for urban boulevards or parkways to enhance the urban environment and to improve the compatibility of major thoroughfares with residential areas. A minimum median width of 7.3 m (24 ft) is recommended with 9.1 m (30 ft) being desirable.

Typical cross section "G" is recommended for major thoroughfares where projected travel indicates a need for four travel lanes but traffic is not excessively high, left turning movements are light, and right-of-way is restricted. An additional left turn lane would probably be required at major intersections. This cross section should be used only if the above criteria is met. If right-of-way is not restricted, future strip development could take place and the inner lanes could become de facto left turn lanes.

In urban environments, thoroughfares which are proposed to function as one-way traffic carriers would typically require **cross section "H". Cross sections "I" and "J"** are usually recommended for urban minor thoroughfares since these facilities usually serve both land service and traffic service functions. **Cross section "I"** would be used on those minor thoroughfares where parking on both sides is needed as a result of more intense development.

Cross section "K" is used in rural areas or for staged construction of a wider multi-lane cross section. On some thoroughfares, projected traffic volumes may indicate that two travel lanes will adequately serve travel for a considerable period of time. For areas that are growing and future widening will be necessary, the full right-of-way of 30 m (100 ft) should be required. In some instances, local ordinances may not allow the full 30 m (100 ft). In those cases, 21 m (70 ft) should be preserved with the understanding that the full 30 m (100 ft) will be preserved by use of building setbacks and future street line ordinances.

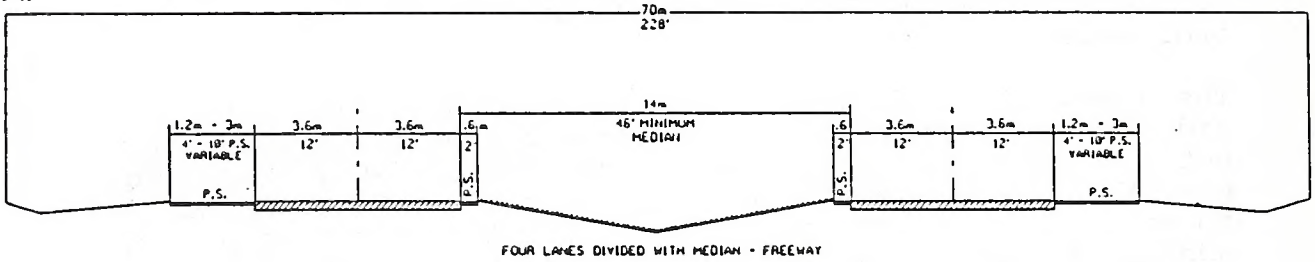
The urban curb and gutter cross sections all illustrate the sidewalk adjacent to the curb with a buffer or utility strip between the sidewalk and the minimum right-of-way line. This permits adequate setback for utility poles. If it is desired to move the sidewalk farther away from the street to provide additional separation for pedestrians or for aesthetic reasons, additional right-of-way must be provided to insure adequate setback for utility poles.

The right-of-ways shown for the typical cross sections are the minimum rights-of-way required to contain the street, sidewalks, utilities, and drainage facilities. Cut and fill requirements may require either additional right-of-way or construction easements. Obtaining construction easements is becoming the more common practice for urban thoroughfare construction.

If there is sufficient bicycle travel along the thoroughfare to justify a bicycle lane or bikeway, additional right-of-way may be required to contain the bicycle facilities. The North Carolina Bicycle Facilities Planning and Design Guidelines should be consulted for design standards for bicycle facilities. **Cross sections N, O, and P** are typically used to accommodate bicycle travel.

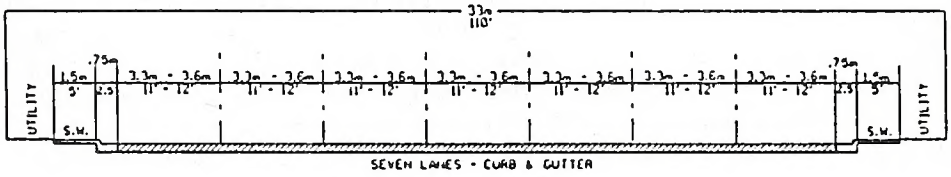
TYPICAL THOROUGHFARE CROSS SECTIONS

A.



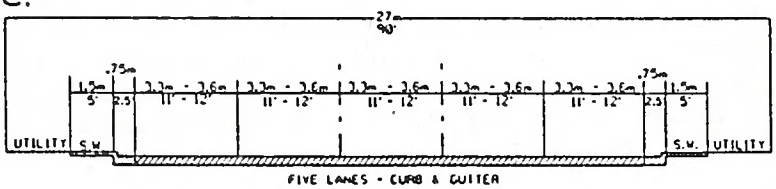
FOUR LANES DIVIDED WITH MEDIAN - FREEWAY

B.



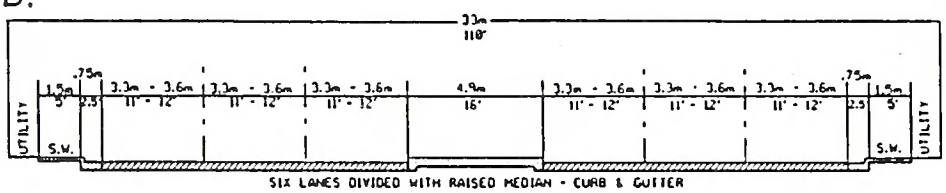
SEVEN LANES - CURB & GUTTER

C.



FIVE LANES - CURB & GUTTER

D.

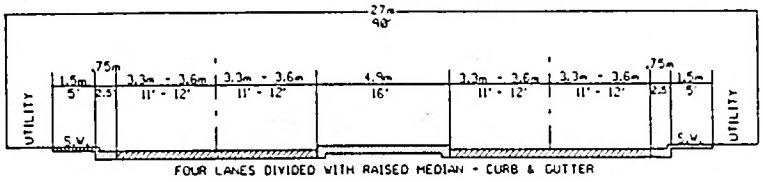


SIX LANES DIVIDED WITH RAISED MEDIAN - CURB & GUTTER

FIGURE 6

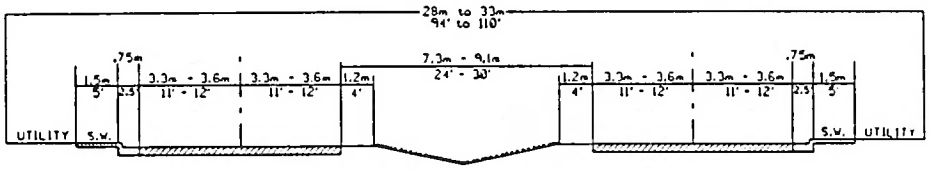
TYPICAL THOROUGHFARE CROSS SECTIONS

E.



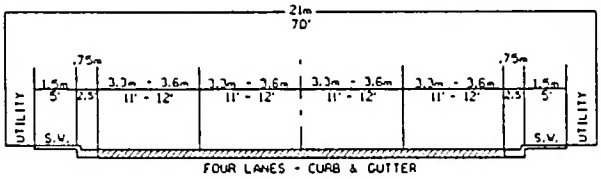
FOUR LANES DIVIDED WITH RAISED MEDIAN - CURB & GUTTER

F.



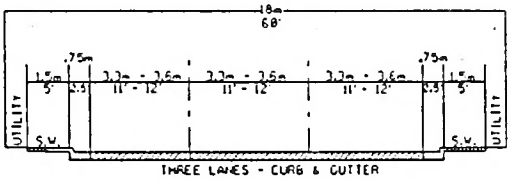
FOUR LANES DIVIDED - BOULEVARD
GRASS MEDIAN

G.



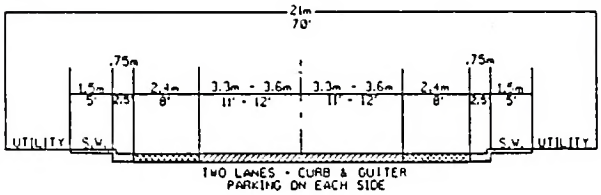
FOUR LANES - CURB & GUTTER

H.



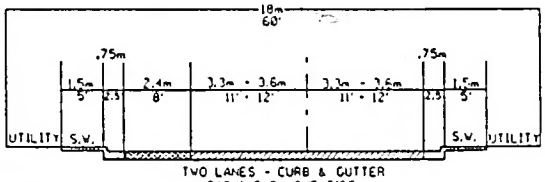
THREE LANES - CURB & GUTTER

I.



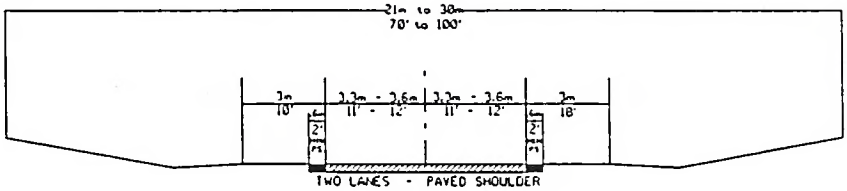
TWO LANES - CURB & GUTTER
PARKING ON EACH SIDE

J.



TWO LANES - CURB & GUTTER
PARKING ON ONE SIDE

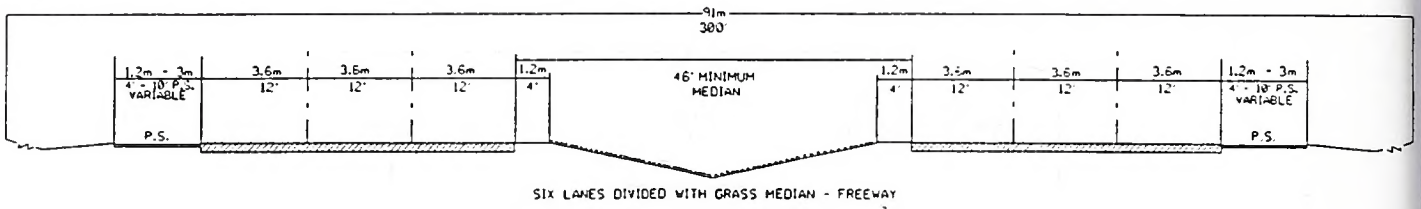
K.



TWO LANES - PAVED SHOULDER

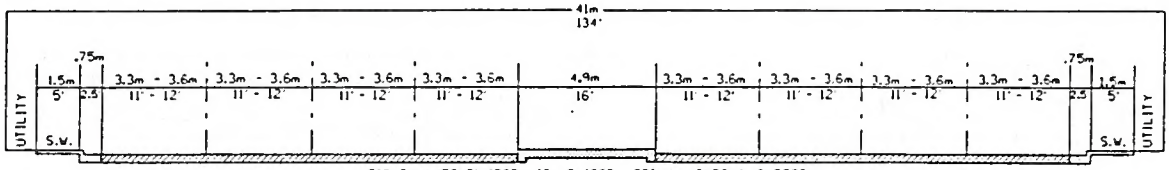
TYPICAL THOROUGHFARE CROSS SECTIONS

L.



SIX LANES DIVIDED WITH GRASS MEDIAN - FREEWAY

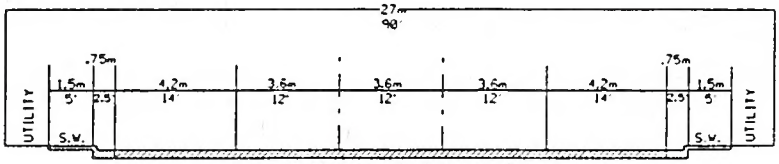
M.



EIGHT LANES DIVIDED WITH RAISED MEDIAN - CURB & GUTTER

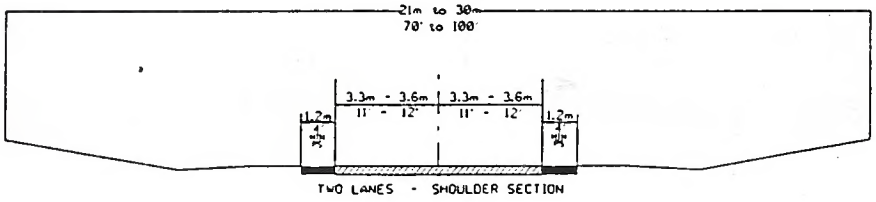
TYPICAL THOROUGHFARE CROSS SECTIONS FOR ACCOMMODATING BICYCLES

N.



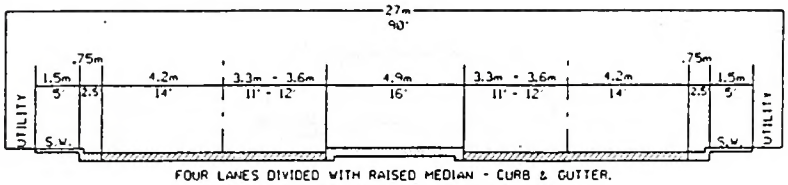
FIVE-LANE ROADWAY WITH CURB & GUTTER.
STANDARD INSIDE LANES & WIDENED CURB LANES

O.



TWO LANES - SHOULDER SECTION

P.



FOUR LANES DIVIDED WITH RAISED MEDIAN - CURB & GUTTER.
STANDARD INSIDE LANES & WIDENED CURB LANES

TABLE 8

THOROUGHFARE PLAN STREET TABULATION AND RECOMMENDATIONS

FACILITY & SECTION	DISTANCE		EXISTING CROSS SECTION					CAPACITY	1991	2020	RECOMMENDED CROSS SECTION		
			ROADWAY		ROW		LNS	CURRENT			RDWAY	ROW (ULT)	
	Km	Mi	m	ft	m	ft	#	(FUTURE)	ADTS	ADTS	(ULT)	m	ft
Allen's Crk. Rd (SR 1147)													
Church St - Way./Haz. CL	0.3	0.2	15.8	52	30	100	2	12,000	5,200	6,000	NC	NC	NC
Way./Hay. CL - US 23 Bus	0.2	0.1	15.8	52	30	100	2	12,000	5,200	6,000	NC	NC	NC
US 23 Bus - SR 1149	1.0	0.6	7.3	24	18	60	2	12,000	2,300	2,700	NC	NC	NC
SR 1149 - PAB	0.4	0.3	6.1	20	---	----	2	10,500	2,300	2,700	NC	NC	NC
Branner Ave													
Haywood St -Russ Ave	0.4	0.3	11.6	38	---	----	2	12,000	----	3,700	NC	NC	NC
Brown Ave													
E. Main St - Boyd Ave	1.2	0.7	9.1	30	---	----	2	12,500	2,940	7,000	NC	NC	NC
Allen's Crk Rd - E. Main	0.4	0.3	6.1	20	---	----	2	10,000	----	3,500	2-LANE 1-WAY EASTBOUND		NC
Country Club Dr (SR 1134)													
US 23 Bus -US 276	1.8	1.1	4.9	16	---	----	2	(9,000)	1,340	2,000	18'	NC	NC
Dellwood Rd Extension													
US 276 -Miller St	0.8	0.5	7.3	24	---	----	2	(24,000)	8,600	20,800	G	21	70
Miller St -Brown Ave	1.0	0.6	--		---	----	-	(12,000)	----	7,000	J	18	60
Elysinia Rd													
E. Main St - US 19/23/74	0.6	0.4	9.1	30	---	----	2	13,000	5,900	8,700	NC	NC	NC
Haywood St													
Branner Ave - Main St	0.8	0.5	7.3	24	---	----	2	12,000	----	7,800	NC	NC	NC
Hazelwood Avenue													
US 23 Bus - US 19/23/74	1.4	0.9	9.1	30	---	----	2	12,500	2,700	5,200	NC	NC	NC

PAB - PLANNING AREA BOUNDARY **ADQ - ADEQUATE** **MP - MILE POST**

NC - NO CHANGE

TABLE 8
THOROUGHFARE PLAN STREET TABULATION AND RECOMMENDATIONS

FACILITY & SECTION	DISTANCE		EXISTING CROSS SECTION					CAPACITY	1991	2020	RECOMMENDED CROSS SECTION		
			ROADWAY		ROW		LNS	CURRENT	ADTS	ADTS	RDWAY	ROW (ULT)	
	Km	Mi	m	ft	m	ft	#	(FUTURE)			(ULT)	m	ft
Miller St													
Delwd Rd Ext - Haywood St	0.4	0.2	9.1	30	---	----	2	13,000	----	11,000	NC	NC	NC
NC 209													
North PAB - US 19A/23/74	2.7	1.7	6.1	20	18	60	2	11,000	4,200	5,600	NC	NC	NC
Racoon Rd (SR 1812)													
SR 1818 - US 276	2.3	1.4	5.5	18	---	----	2	9,000	1,300	3,700	NC	NC	NC
Ratcliff Cove Rd (SR 1818)													
SR 1802 - US 23 Bus	1.2	0.8	4.9	16	---	----	2	(9,000)	3,700	4,300	18'	NC	NC
Riverbend St													
E. Main - Allen's Crk Rd	0.5	0.3	6.1	20	---	----	2	10,000	----	3,500	2-LANE 1-WAY		
Sulphur Sprgs./Smathers St													
E. Main St - Delwd Rd Ext	1.8	1.1	7.0	23	---	----	2	11,500	3,670	3,400	NC	NC	NC
US 19													
US 276 - MP 11.91	1.9	1.2	19.5	64	30	100	4	54,000	8,800	16,500	NC	NC	NC
MP 11.91 - US 19A/23/74	0.2	0.1	14.6	48	30	100	4	54,000	8,800	16,500	NC	NC	NC
US 276 -MP 11.91	1.9	1.2	19.5	64	30	100	4	54,000	8,800	16,500	NC	NC	NC
MP 11.91 - US 19A/23/74	0.2	0.1	14.6	48	30	100	4	54,000	8,800	16,500	NC	NC	NC
US 19A/23/74 - NC 209	0.9	0.5	14.6	48	52	170	4	54,000	21,600	34,500	NC	NC	NC
NC 209 - East PAB	0.3	0.2	14.6	48	79	260	4	54,000	25,700	34,500	NC	NC	NC
US 19A/23/74 Bypass													
West PAB -US 23 Bus	0.9	0.6	19.5	64	30	100	4	54,000	14,100	23,900	NC	NC	NC
US 23 Bus -SR 1173	1.6	1.0	19.5	64	30	100	4	54,000	17,300	22,200	NC	NC	NC
SR 1173 - US 276	3.7	2.3	19.5	64	30	100	4	54,000	21,500	31,600	NC	NC	NC
US 276 - US 19	2.6	1.6	19.5	64	30	100	4	54,000	21,600	31,600	NC	NC	NC
US 19 - East PAB	1.2	0.8	14.6	48	80	260	4	54,000	25,700	34,500	NC	NC	NC

PAB - PLANNING AREA BOUNDARY ADQ - ADEQUATE MP - MILE POST

NC - NO CHANGE

APPENDIX B
THOROUGHFARE PLANNING PRINCIPLES

Objectives

Typically, the urban street system occupies 25 to 30 percent of the total developed land in an urban area. Since the system is permanent and expensive to build and maintain, care and foresight are needed in its development. Thoroughfare planning is the process public officials use to assure the development of the most appropriate street system to meet the existing and future travel desires within the urban area.

The primary aim of a thoroughfare plan is to guide the development of the urban street system in a manner consistent with changing traffic demands. Through proper planning for street development, costly errors and needless expense can be averted. A thoroughfare plan will enable street improvements to be made as traffic demands increase, and help eliminate unnecessary improvements. By developing the urban street system to keep pace with increasing traffic demands, a maximum utilization of the system can be attained that will require a minimum amount of land for street purposes. In addition to providing for traffic needs, the thoroughfare plan should embody those details of good urban planning necessary to present a pleasing and efficient urban community. The location of present and future population, commercial enterprises, and industry affects major street and highway locations. Conversely, the location of major streets and highways within the urban area will influence the urban development pattern.

Other objectives of a thoroughfare plan include:

(1) To provide for the orderly development of an adequate major street system as land development occurs;

(2) To reduce travel and transportation costs;

(3) To reduce the cost of major street improvements to the public through the coordination of a street system with private action;

(4) To enable private interests to plan their actions, improvements, and development with full knowledge of public intent;

(5) To minimize disruption and displacement of people and businesses through long range advance planning for major street improvements;

(6) To reduce environmental impacts such as air pollution, resulting from transportation;

(7) To increase travel safety.

Thoroughfare planning objectives are achieved through both: **(1)** improving the operational efficiency of thoroughfares; and **(2)** improving the system efficiency through system coordination and layout.

Operational Efficiency

A street's operational efficiency is improved by increasing the capability of the street to carry vehicular traffic and people. In terms of vehicular traffic, a street's capacity is defined as the maximum number of vehicles which can pass a given point on a roadway during a given time period under prevailing roadway and traffic conditions. Capacity is affected by the physical features of the roadway, nature of traffic, and weather.

Physical ways to improve vehicular capacity include **street widening**, **intersection improvements**, **improving vertical** and **horizontal alignment**, and **eliminating roadside obstacles**. For example, widening of a street from two to four travel lanes more than doubles the capacity of the street by providing additional maneuverability for traffic. Impedances to traffic flow caused by slow moving or turning vehicles and adverse effects of horizontal and vertical alignments are thus reduced.

Operational ways to improve street capacity include:

(1) **Control of access** - A roadway with complete access control can often carry three times the traffic handled by a non-controlled access street with identical lane widths and number of lanes.

(2) **Parking removal** - Increases capacity by providing additional street width for traffic flow and reducing friction to flow caused by parking and unparking vehicles.

(3) **One-way operation** - The capacity of a street can sometimes be increased 20-50%, depending upon turning movements and overall street width, by initiating one-way traffic operations. One-way streets can also improve traffic flow by decreasing potential traffic conflicts and simplifying traffic signal coordination.

(4) **Reversible lanes** - Reversible traffic lanes may be used to increase street capacity in situations where heavy directional flows occur during peak periods.

(5) **Signal phasing and coordination** - Uncoordinated signals and poor signal phasing restrict traffic flow by creating excessive stop-and-go operation.

Altering travel demand is a third way to improve the efficiency of existing streets. Travel demand can be reduced or altered in the following ways:

(1) Encourage people to form **carpools** and **vanpools** for journeys to work and other trip purposes. This reduces the number of vehicles on the roadway and raises the people carrying capability of the street system.

(2) Encourage the use of alternate modes of travel such as **transit** and **bicycles.**

(3) Encourage industries, business, and institutions to **stagger work hours** or establish variable work hours for employees. This will reduce travel demand in peak periods and spread peak travel over a longer time period.

(4) Plan and encourage **land use development** or redevelopment in a more travel efficient manner.

System Efficiency

Another means of altering travel demand is the development of a more efficient system of streets that will better serve travel desires. A more efficient system can reduce travel distances, time, and cost. Improvements in system efficiency can be achieved through the concept of functional classification of streets and development of a coordinated major street system.

Functional Classification

Streets perform two primary functions -- traffic service and land access -- which when combined, are basically incompatible. The conflict is not serious if both traffic and land service demands are low. However, when traffic volumes are high, conflicts created by uncontrolled and intensely used abutting property lead to intolerable traffic flow friction and congestion.

The underlying concept of the thoroughfare plan is that it provides a functional system of streets which permits travel from origins to destinations with directness, ease and safety. Different streets in this system are designed and called on to perform specific functions, thus minimizing the traffic and land service conflict. Streets are categorized as to whether they function as local access streets, minor thoroughfares or major thoroughfares (see Figure 7).

Local access streets provide access to abutting property. They are not intended to carry heavy volumes of traffic and should be located such that only traffic with origins and destinations on the streets would be served. Local streets may be further classified as either residential, commercial and/or industrial depending upon the type of land use which they serve.

Minor thoroughfares are more important streets in the city system. They collect traffic form local access streets and carry it to the major thoroughfare system. They may in some instances supplement the major thoroughfare system by facilitating minor through traffic movements. A third function which may be performed is that of providing access to abutting property. They should be designed to serve limited areas so that their development as major thoroughfares will be prevented.

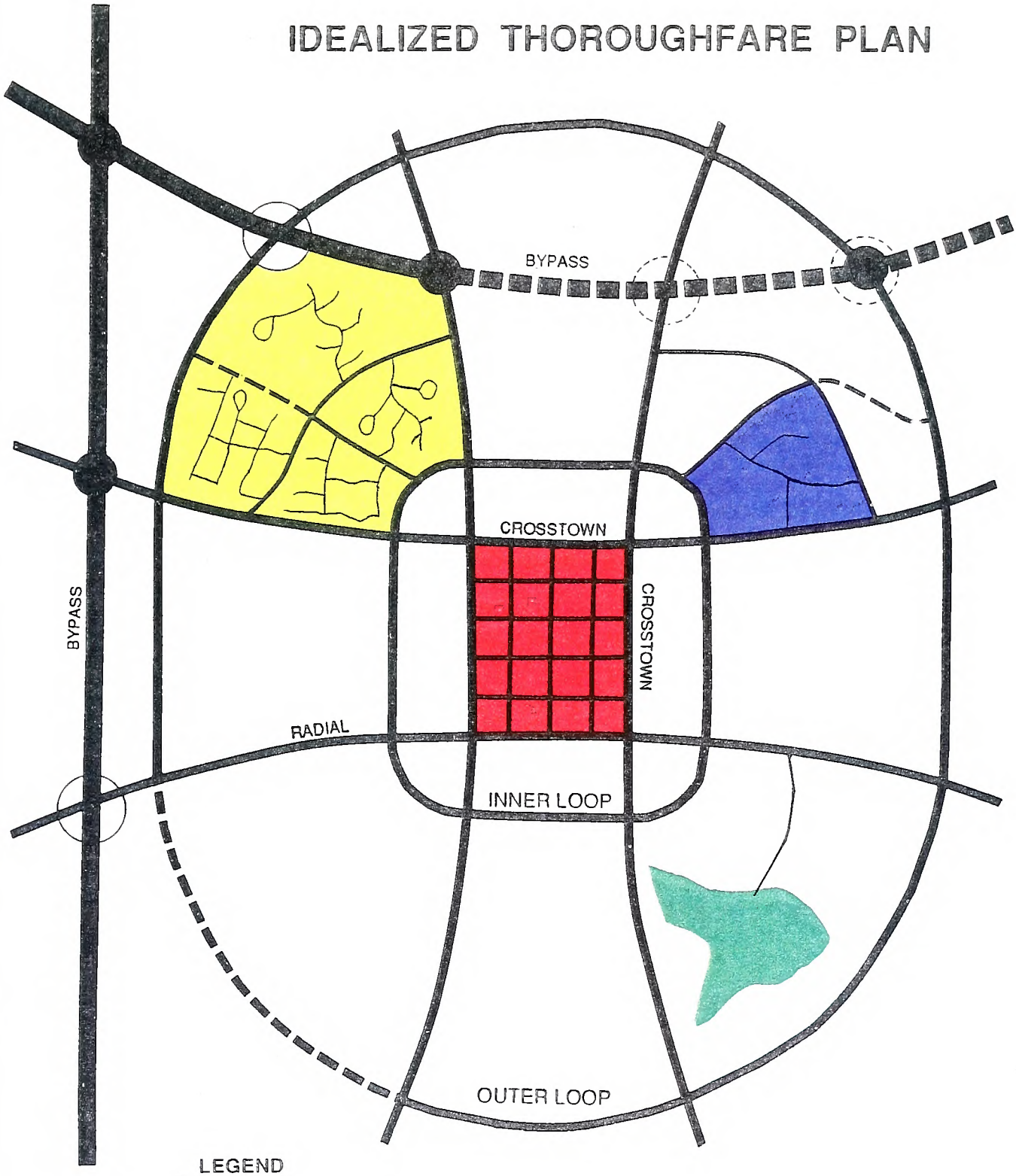
Major thoroughfares are the primary traffic arteries of the city. Their function is to move intra-city and inter-city traffic. The streets which comprise the major thoroughfare system may also serve abutting property; however, THEIR MAJOR FUNCTION IS TO CARRY TRAFFIC. They should not be bordered by uncontrolled strip development because such development significantly lowers the capacity of the thoroughfare to carry traffic and each driveway is a danger and an impediment to traffic flow. Major thoroughfares may range from a two-lane street carrying minor traffic volumes to major expressways with four or more traffic lanes. Parking normally should not be permitted on major thoroughfares.

Idealized Major Thoroughfare System

A coordinated system of major thoroughfares forms the basic framework of the urban street system. A major thoroughfare system which is most adaptable to desire lines of travel within an urban area and which permits movement between various areas of the city with maximum directness is the radial-loop system. This system consists of several functional elements-radial streets, crosstown streets, loop system streets, and bypasses (Figure 7).

Radial streets provide for traffic movement between points located in the outskirts of the city and the central area. This is a major traffic movement in most cities, and the economic strength of the central business district depends upon the adequacy of this type of thoroughfare.

IDEALIZED THOROUGHFARE PLAN



LEGEND

	EXISTING	PROPOSED
MAJOR THOROUGHFARE FREEWAY		
MAJOR OTHER		
MINOR THOROUGHFARE		
LOCAL ROAD		
INTERCHANGE		
GRADE SEPERATION		

LAND USES

- COMMERCIAL/BUSINESS
- RESIDENTIAL
- INDUSTRIAL
- PUBLIC/INSTITUTIONAL

FIGURE 7

If all radial streets crossed in the central area, an intolerable congestion problem would result. To avoid this problem, it is very important to have a system of **crosstown streets** which form a loop around the central business district. This system allows traffic moving from origins on one side of the central area to destinations on the other to follow the area's border and allows central area traffic to circle and then enter the area near a given destination. The effect of a good crosstown system is to free the central area of crosstown traffic, thus permitting the central area to function more adequately in its role as a pedestrian shopping area.

Loop system streets move traffic between suburban areas of the city. Although a loop may completely encircle the city, a typical trip may be from an origin near a radial thoroughfare to a destination near another radial thoroughfare. Loop streets do not necessarily carry heavy volumes of traffic, but they function to relieve central areas. There may be one or more loops, depending on the size of the urban area, and they are generally spaced one-half mile to one mile apart, depending on the intensity of the land use.

A **bypass** is designed to carry traffic through or around the urban area, thus providing relief to the city street system by removing from it traffic which has no desire to be in the city. Bypasses are usually designed to through highway standards, with control of access. Occasionally, a bypass with low traffic volume can be designed to function as a portion of an urban loop. The general effect of bypasses is to expedite the movement of through traffic and to improve traffic conditions within the city. By freeing the local streets for use by shopping and home-to-work traffic, bypasses tend to increase the economic vitality of the local area.

Application of Thoroughfare Planning Principles

The concepts presented in the discussion of operational efficiency, system efficiency, functional classification, and idealized major thoroughfare system are the conceptual tools available to the transportation planner in developing a thoroughfare plan. In actual practice, thoroughfare planning is done for established urban areas and is constrained by existing land use and street patterns, existing public attitudes and goals, and current expectations of future land use. Compromises must be made because of these and the many other factors that affect major street locations.

Throughout the thoroughfare planning process it is necessary from a practical viewpoint that certain basic principles be followed as closely as possible. These principles are as follows:

(1) The plan should be derived from a thorough knowledge of today's travel - its component parts, as well as the factors that contribute to it, limit it, and modify it.

(2) Traffic demands must be sufficient to warrant the designation and development of each major street. The thoroughfare plan should be designed to accommodate a large portion of all major traffic movements on a relatively few streets.

(3) The plan should conform to and provide for the land development plan of the area.

(4) Certain considerations must be given to urban development beyond the current planning period. Particularly in outlying or sparsely developed areas which have development potential, it is necessary to designate thoroughfares on a long-range planning basis to protect rights-of-way for future thoroughfare development.

(5) While being consistent with the above principles and realistic in terms of travel trends, the plan must be economically feasible.

APPENDIX C
TRAVEL FORECASTING TECHNIQUES

Base Year 1991 Travel

Typically, the travel patterns in an urban area the size of Waynesville-Hazelwood have been modeled by hand using the allocation approach (Technical Report #11, NCDOT Statewide Planning Branch, May 1989). For this study however, it was decided to use the TRANPLAN computer software package so that testing of alternatives and computation of benefits would be easier. In larger "contract" studies detailed socio-economic data is collected and used as input to the TRANPLAN model. This data requires counting every dwelling unit in the planning area and rating each in one of five categories based on their estimated trip-generation potential. Employment data consists of obtaining the number of employees, commercial autos, and trucks for each employer in the planning area.

Each categorized house functions as a trip generator in the model and each employer attracts trips. The relative attractiveness between employers is determined by the number of employees and type of business (i.e. a fast food restaurant attracts a significantly higher number of trips per day per employee than does a factory).

Because the Waynesville-Hazelwood study is not a contract study, the resources were not available to conduct the intensive data collection required for "full-blown" model development. However the following steps were taken to build an adequate base-year (1991) traffic model for the Waynesville-Hazelwood planning area:

1) Aerial photography was obtained from the Town of Waynesville that encompassed the entire planning area. The planning area was then separated into 14 traffic analysis zones with an attempt to group similar land-uses within zones.

2) Houses were counted on the aerial photography. Houses were not rated and instead were all assigned the same generation rate. The population of the planning area was computed by multiplying the number of houses and the persons/dwelling unit factor for Haywood County (supplied by the Office of State Planning).

3) Major employers were listed on a map during a windshield survey of the planning area. The total number of employees in the planning area was computed by multiplying the Haywood County employment/population ratio (supplied by the Office of State Planning) and the population (step 2). Total employees were then allocated to the zones by estimated percentages.

4) The relative attractiveness of employers was controlled in the model by regression equations that had been developed for the 1976 Canton Thoroughfare Plan. The relative attractiveness of

travel times is controlled by friction factors. The friction factors are developed by entering a trip length frequency curve into the Calibrate Gravity Model. The trip length frequency curve was also borrowed from the 1976 Canton Thoroughfare Plan. Internal trip distribution by type {home-based work (HBW), other home-based (OHB), non home-based (NHB)} was also borrowed from the Canton Study.

5) Traffic counts were taken in about 10 locations in the planning area in March of 1993. These counts were used to supplement the counts on the Haywood County ADT map which is produced by the Traffic Surveys Unit of the Statewide Planning Branch. At the time the model was built, the most comprehensive ADT map contained 1991 traffic counts. So, the supplementary 1993 counts were factored back for consistency.

6) The base year model was calibrated to 1991 counts by adjustments to the trip length frequency curve; introduction of different generation rates in some zones; and adjustments to times and connections of centroid links.

Design Year 2020 Travel

After the base year model was calibrated, housing and employment growth was projected to the year 2020. The Towns provided general forecasts of the type and location of growth. From the information provided by the Towns it was projected that the land use would basically remain unchanged with housing growth located in zones as indicated by Town representatives.

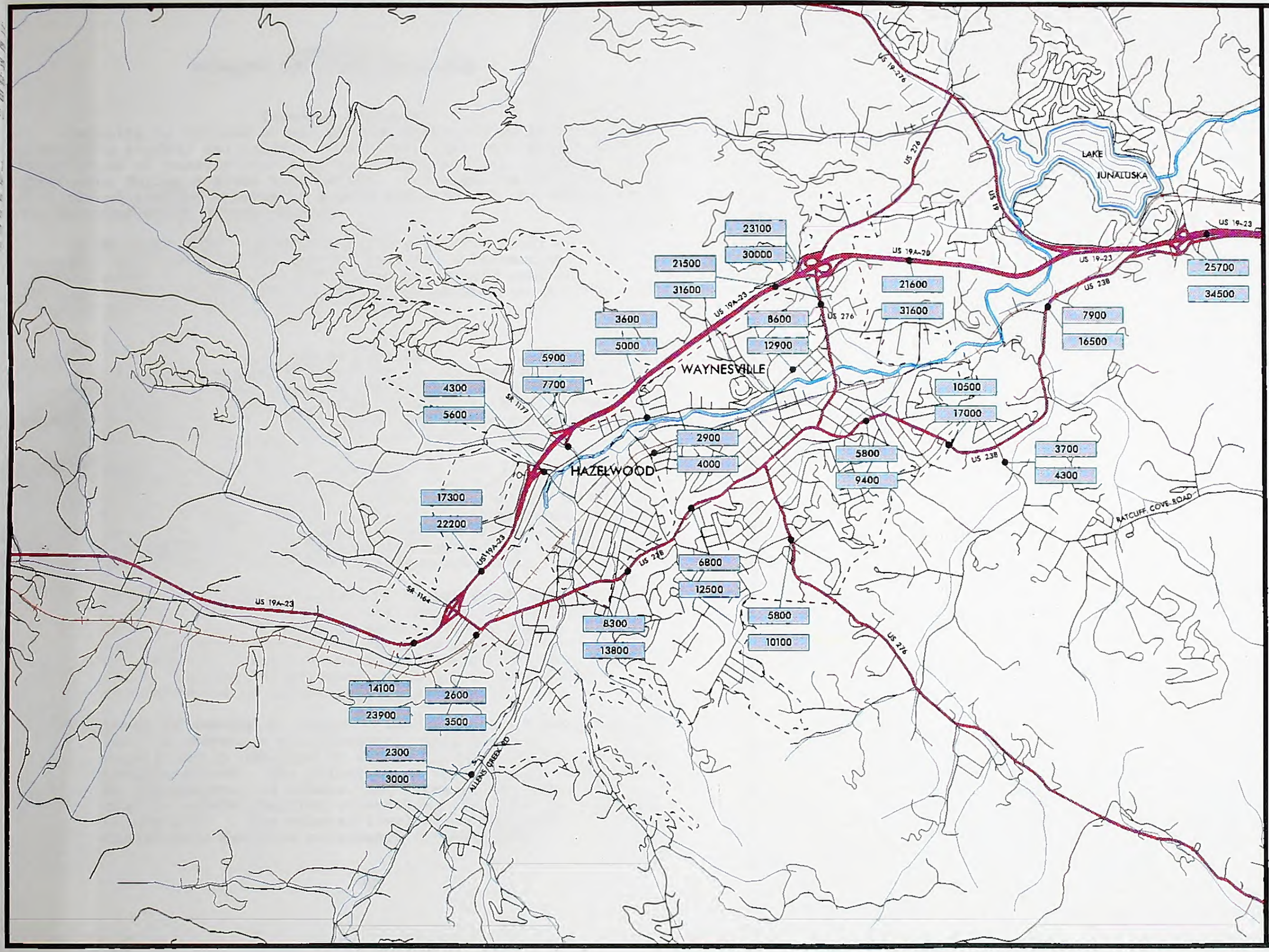
Future employment was computed by holding a constant employment/population ratio and multiplying it by the projected population. Because the location and types of employment were projected to remain the same, employment growth was allocated to the zones in the same proportions as the existing employment. This resulted in travel patterns remaining basically the same in the design year. Population was projected based on County and Township trends and a projected persons/dwelling unit ratio was used to derive projected houses. The housing growth was then allocated to the appropriate zones. This data yielded the projected traffic (see Figure 8).

EXISTING NETWORK WITH CURRENT AND PROJECTED TRAFFIC

LEGEND:

1991 ADT

2020 ADT



WAYNESVILLE

AND VICINITY

FIGURE 8

APPENDIX D
CAPACITY AND LEVELS OF SERVICE

Capacity Analysis

Capacity is defined as the maximum number of vehicles, under prevailing roadway and traffic conditions, that have a reasonable expectation of passing over a given roadway section in one or both directions during a given time period. A comparison of capacity with actual traffic volumes is a good indicator of the adequacy of the existing major street network.

In an urban area, a street's ability to move traffic is generally controlled by the spacing of major intersections, the pavement width, and the type and number of traffic control devices. These characteristics can be manipulated to increase the capacity and improve the level of service.

Levels of Service

The level of service is a function of the ease of movement experienced by motorists using the facility. Six levels of service, shown in Figure 9, have been selected to identify the conditions existing under various speed and volume conditions on any highway or street. The six levels of service are:

1. **Level of service A** - A condition of free flow with low traffic volumes and high speeds. Individual users are virtually unaffected by the presence of others in the traffic stream. Freedom to select desired speeds and to maneuver within the traffic stream is extremely high. The general level of comfort and convenience provided to the motorist, passenger, or pedestrian is excellent.

2. **Level of service B** - A zone of stable flow, where the presence of other users in the traffic stream begins to be noticeable. Freedom to select desired speeds is relatively unaffected, but there is a slight decline in the freedom to maneuver within the traffic stream from LOS A, because the presence of others in the traffic stream begins to affect individual behavior.

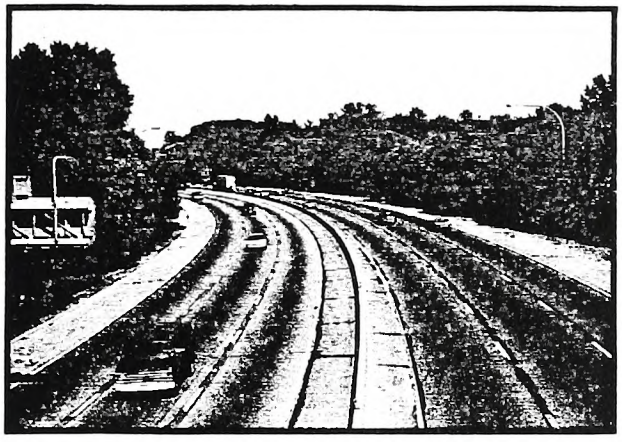
3. **Level of service C** - Also in the range of stable flow, but the operation of individual users becomes significantly affected by interactions with others in the traffic stream. The selection of speed is now affected by the presence of others, and maneuvering within the traffic stream requires substantial vigilance on the part of the user. The general level of comfort and convenience declines noticeably at this level.

4. **Level of service D** - Approaches unstable flow, where speed and freedom to maneuver are severely restricted. The driver or pedestrian experiences a generally poor level of comfort and convenience. Small increases in traffic flow will generally cause operational problems at this level.

5. **Level of service E** - Represents operating conditions at or near the capacity level. All speeds are reduced to a low, but relatively uniform value. Maneuvering within the traffic stream is extremely difficult, and it is generally accomplished by forcing a vehicle or pedestrian to "give way" to accommodate such maneuvers. Comfort and convenience levels are extremely poor. Driver and pedestrian frustration is generally high. Operations at this level are usually unstable because small increases in flow or minor perturbations within the traffic stream will cause breakdowns.

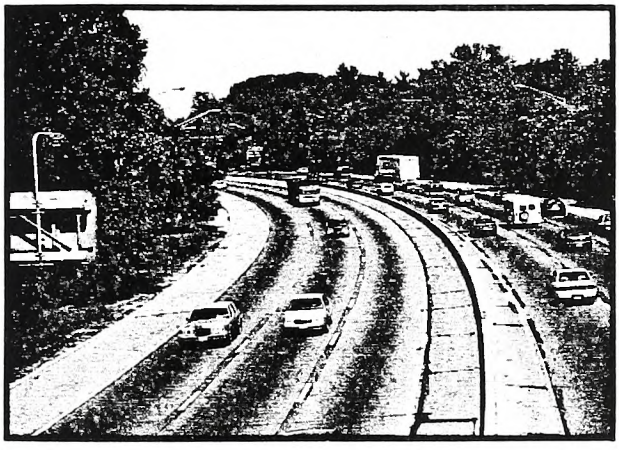
6. **Level of service F** - Forced flow operations at low speeds, where volumes are below capacity. This condition exists wherever the amount of traffic approaching a point exceeds the amount which can traverse the point. Queues form behind such locations. Operations within the queue are characterized by stop-and-go waves, and they are extremely unstable. Vehicles may progress at reasonable speeds for several hundred feet or more, then be required to stop in a cyclic fashion. Level-of-service F is used to describe the operating conditions within the queue, as well as the point of the breakdown. In many cases, operating conditions of vehicles or pedestrians discharged from the queue may be quite good. It is the point at which arrival flow exceeds discharge flow which causes the queue to form. Level-of-service F is an appropriate designation for such points.

Source: 1994 Highway Capacity Manual

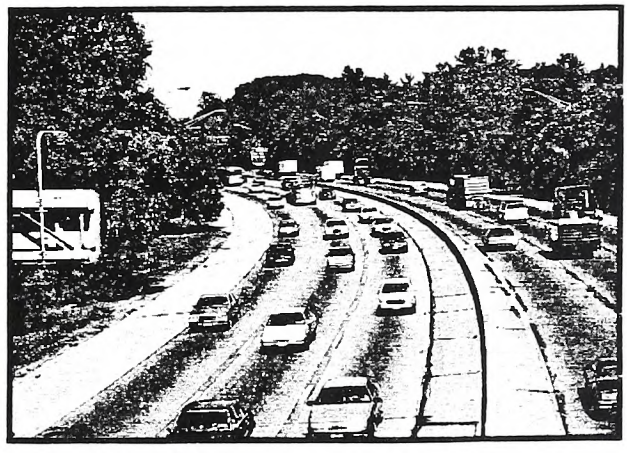


LOS A.

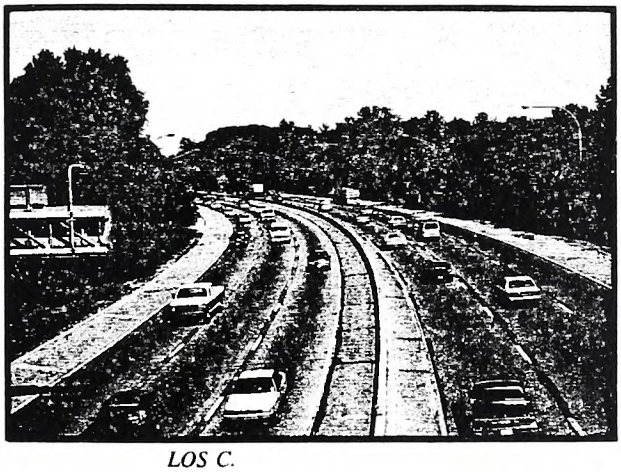
LOS D.



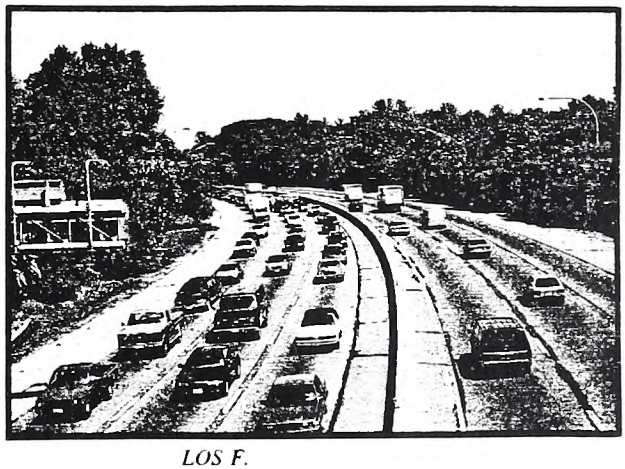
LOS B.



LOS E.



LOS C.



LOS F.

LEVELS OF SERVICE

FIGURE 9

Appendix E

RECOMMENDED SUBDIVISION ORDINANCES

Note: English equivalents are printed in this report merely as a guide. The English measurements were not meant to represent exact conversions, and should not be used for standards, regulations, or construction. The tables in this section were taken from the Roadway Design Metric Design Manual. In the event of conflicting information, the Standard Specifications for Roads and Structures and the Roadway Design Metric Design Manual should serve as the standard.

Appendix E

RECOMMENDED SUBDIVISION ORDINANCES

DEFINITIONS

I. Streets and Roads

A. Rural Roads

1. Principal Arterial - A rural link in a highway system serving travel, and having characteristics indicative of substantial statewide or interstate travel and existing solely to serve traffic. This network would consist of Interstate routes and other routes designated as principal arterials.

2. Minor Arterial - A rural roadway joining cities and larger towns and providing intra-state and inter-county service at relatively high overall travel speeds with minimum interference to through movement.

3. Major Collector - A road which serves major intra-county travel corridors and traffic generators and provides access to the Arterial system.

4. Minor Collector - A road which provides service to small local communities and traffic generators and provides access to the Major Collector system.

5. Local Road - A road which serves primarily to provide access to adjacent land, over relatively short distances.

B. Urban Streets

1. Major Thoroughfares - Major thoroughfares consist of Inter-state, other freeway, expressway, or parkway roads, and major streets that provide for the expeditious movement of high volumes of traffic within and through urban areas.

2. Minor Thoroughfares - Minor thoroughfares perform the function of collecting traffic from local access streets and carrying it to the major thoroughfare system. Minor thoroughfares may be used to supplement the major thoroughfare system by facilitating minor through traffic movements and may also serve abutting property.

3. Local Street - A local street is any street not on a higher order urban system and serves primarily to provide direct access to abutting land.

C. Specific Type Rural or Urban Streets

1. Freeway, expressway, or parkway - Divided multilane roadways designed to carry large volumes of traffic at high speeds. A freeway provides for continuous flow of vehicles with no direct access to abutting property and with access to selected crossroads only by way of interchanges. An expressway is a facility with full or partial control of access and generally with grade separations at major intersections. A parkway is for non-commercial traffic, with full or partial control of access.

2. Residential Collector Street - A local street which serves as a connector street between local residential streets and the thoroughfare system. Residential collector streets typically collect traffic from 100 to 400 dwelling units.

3. Local Residential Street - Cul-de-sacs, loop streets less than 760 meters (2500 ft) in length, or streets less than 1.6 kilometers (1.0 miles) in length that do not connect thoroughfares, or serve major traffic generators, and do not collect traffic from more than 100 dwelling units.

4. Cul-de-sac - A short street having only one end open to traffic and the other end being permanently terminated and a vehicular turn-around provided.

5. Frontage Road - A road that is parallel to a partial or full access controlled facility and provides access to adjacent land.

6. Alley - A strip of land, owned publicly or privately, set aside primarily for vehicular service access to the back side of properties otherwise abutting on a street.

II. Property

A. Building Setback Line - A line parallel to the street in front of which no structure shall be erected.

B. Easement - A grant by the property owner for use by the public, a corporation, or person(s), of a strip of land for a specific purpose.

C. Lot - A portion of a subdivision, or any other parcel of land, which is intended as a unit for transfer of ownership or for development or both. The word "lot" includes the words "plat" and "parcel".

III. Subdivision

A. Subdivider - Any person, firm, corporation or official agent thereof, who subdivides of develops any land deemed to be a subdivision.

B. Subdivision - All divisions of a tract or parcel of land into two or more lots, building sites, or other divisions for the purpose, immediate or future, of sale or building development and all divisions of land involving the dedication of a new street or change in existing streets; provided, however, that the following shall not be included within this definition nor subject to these regulations: (1) the combination or re-combination of portions of previously platted lots where the total number of lots is not increased and the resultant lots are equal to or exceed the standards contained herein; (2) the division of land into parcels greater than 4 hectares (10 acres) where no street right-of-way dedication is involved, (3) the public acquisition, by purchase, of strips of land for the widening or the opening of streets; (4) the division of a tract in single ownership whose entire area is no greater than 0.8 hectares (2 acres) into not more than three lots, where no street right-of-way dedication is involved and where the resultant lots are equal to or exceed the standards contained herein.

C. Dedication - A gift, by the owner, of his property to another party without any consideration being given for the transfer. The dedication is made by written instrument and is completed with an acceptance.

D. Reservation - Reservation of land does not involve any transfer of property rights. It constitutes an obligation to keep property free from development for a stated period of time.

DESIGN STANDARDS

I. Streets and Roads

The design of all roads within the Planning Area shall be in accordance with the accepted policies of the North Carolina Department of Transportation, Division of Highways, as taken or modified from the American Association of State Highway Officials' (AASHTO) manuals.

The provision of street rights-of-way shall conform and meet the recommendations of the Thoroughfare Plan, as adopted by the municipality.

The proposed street layout shall be coordinated with the existing street system of the surrounding area. Normally the proposed streets should be the extension of existing streets if possible.

A. Right-of-way Widths - Right-of-way (ROW) widths shall not be less than the following and shall apply except in those cases where ROW requirements have been specifically set out in the Thoroughfare Plan.

	Min. ROW	
1. Rural		
a. Principle Arterial		
Freeways	105 m	(350 ft)
Other	60 m	(200 ft)
b. Minor Arterial	30 m	(100 ft)
c. Major Collector	30 m	(100 ft)
d. Minor Collector	24 m	(80 ft)
e. Local Road	18 m[1]	(60 ft)
2. Urban		
a. Major Thoroughfare other than Freeway and Expressway	27 m	(90 ft)
b. Minor Thoroughfare	21 m	(70 ft)
c. Local Street	18 m[1]	(60 ft)
d. Cul-de-sac	Variable[2]	

The subdivider will only be required to dedicate a maximum of 30 meters (100 ft) of right-of-way. In cases where over 30 meters (100 ft) of right-of-way is desired, the subdivider will be required only to reserve the amount in excess of 30 meters (100 ft). On all cases in which right-of-way is sought for a fully controlled access facility, the subdivider will only be required to make a reservation. It is strongly recommended that subdivisions provide access to properties from internal streets, and that direct property access to major thoroughfares, principle and minor arterials, and major collectors be avoided. Direct property access to minor thoroughfares is also undesirable.

A partial width right-of-way, not less than 18 meters (60 ft) in width, may be dedicated when

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[1] The desirable minimum right-of-way (ROW) is 18 meters (60 ft). If curb and gutter is provided, 15 meters (50 ft) of ROW is adequate on local residential streets.

[2] The ROW dimension will depend on radius used for vehicular turn around. Distance from edge of pavement of turn around to ROW should not be less than distance from edge of pavement to ROW on street approaching turn around.

adjoining undeveloped property that is owned or controlled by the subdivider; provided that the width of a partial dedication be such as to permit the installation of such facilities as may be necessary to serve abutting lots. When the said adjoining property is sub-divided, the remainder of the full required right-of-way shall be dedicated.

B. Street Widths - Widths for street and road classifications other than local shall be as recommended by the Thoroughfare Plan. Width of local roads and streets shall be as follows:

1. Local Residential
   Curb and Gutter section: 7.8 meters (26 ft), face to face of curb
   Shoulder section: 6.0 meters (20 ft) to edge of pavement, 1.2 meters (4 ft) for shoulders

2. Residential Collector
   Curb and Gutter section: 10.2 meters (34 ft), face to face of curb
   Shoulder section: 6.0 meters (20 ft) to edge of pavement, 1.8 meters (6 ft) for shoulders

C. Geometric Characteristics - The standards outlined below shall apply to all subdivision streets proposed for addition to the State Highway System or Municipal Street System. In cases where a subdivision is sought adjacent to a proposed thoroughfare corridor, the requirements of dedication and reservation discussed under Right-of-Way shall apply.

1. Design Speed - The design speed for a roadway should be a minimum of 10 km/h (5 mph) greater than the posted speed limit. The design speeds for subdivision type streets shall be:

DESIGN SPEEDS (METRIC)			
Facility Type	Design Speed km/h Desirable	Minimum Level	Rolling
RURAL			
Minor Collector Roads (ADT Over 2000)	100	80	60
Local roads including Residential Collectors and Local Residential (ADT Over 400)	80	80	60
URBAN			
Major Thoroughfares other than Freeway or Expressway	100	60	60
Minor Thoroughfares	100	50	50
Local Streets	50	50	30

DESIGN SPEEDS (ENGLISH)			
Facility Type	Design Speed mph Desirable	Minimum Level	Rolling
RURAL			
Minor Collector Roads (ADT Over 2000)	60	50	40
Local roads including Residential Collectors and Local Residential (ADT Over 400)	50	* 50	* 40
URBAN			
Major Thoroughfares other than Freeway or Expressway	60	50	40
Minor Thoroughfares	40	30	30
Local Streets	30	**30	**20

* Based on ADT of 400-750. Where roads serve a limited area and small number of units, can reduce min design speed.

**Based on projected ADT of 50-250.
(Reference NCDOT Roadway Design Manual page 1-1B)

2. Maximum and Minimum Grades

a. The maximum grades in percent shall be:

MAXIMUM VERTICAL GRADE (METRIC)				
Facility Type	Design Speed (km/h)	Maximum Grade (Percent) Flat	Rolling	Mountainous
RURAL				
Minor Collector Roads*	30	7	10	12
	50	7	9	10
	65	7	8	10
	80	6	7	9
	100	5	6	8
	110	4	5	6
Local roads including Residential Collectors and Local Residential Streets*	30	-	11	16
	50	7	10	14
	65	7	9	12
	80	6	8	10
	100	5	6	-
URBAN				
Major Thoroughfares other than Freeway or Expressway	50	8	9	11
	65	7	8	10
	80	6	7	9
	100	5	6	8
Minor Thoroughfares*	30	9	12	14
	50	9	11	12
	65	9	10	12
	80	7	8	10
	100	6	7	9
	110	5	6	7
Local Streets*	30	-	11	16
	50	7	10	14
	65	7	9	12
	80	6	8	10
	100	5	6	-

* For streets and roads with projected annual average daily traffic less than 250 or short grades less than 150 meters (500 ft) long, grades may be 2% steeper than the values in the above table.

(Reference NCDOT Roadway Metric Design Manual page 1-12 T-3)

MAXIMUM VERTICAL GRADE (ENGLISH)				
Facility Type	Design Speed (mph)	Maximum Grade (Percent) Flat	Rolling	Mountainous
RURAL				
Minor Collector Roads*	20	7	10	12
	30	7	9	10
	40	7	8	10
	50	6	7	9
	60	5	6	8
	70	4	5	6
Local roads including Residential Collectors and Local Residential Streets*	20	-	11	16
	30	7	10	14
	40	7	9	12
	50	6	8	10
	60	5	6	-
URBAN				
Major Thoroughfares other than Freeway or Expressway	30	8	9	11
	40	7	8	10
	50	6	7	9
	60	5	6	8
Minor Thoroughfares*	20	9	12	14
	30	9	11	12
	40	9	10	12
	50	7	8	10
	60	6	7	9
	70	5	6	7
Local Streets*	20	-	11	16
	30	7	10	14
	40	7	9	12
	50	6	8	10
	60	5	6	-

b. Minimum grade should not be less than 0.5% .

c. Grades for 30 meters (100 ft) each way from intersections (measured from edge of pavement) should not exceed 5%.

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* For streets and roads with projected annual average daily traffic less than 250 or short grades less than 150 meters (500 ft) long, grades may be 2% steeper than the values in the above table.

(Reference NCDOT Roadway Design Manual page 1-12 T-3)

3. Minimum Sight Distance - In the interest of public safety, no less than the minimum sight distance applicable shall be provided. Vertical curves that connect each change in grade shall be provided and calculated using the following parameters:

SIGHT DISTANCE (METRIC)					
Design Speed (km/h)	30	50	60	90	100
Stopping Sight Distance					
Minimum (meters)	29.6	57.4	74.3	131.2	157.0
Desirable (meters)	30	70	90	170	210
Minimum K* Value for:					
Crest curve	3	9	14	43	62
Sag curve	4	11	15	30	37
Passing Sight Distance:					
Minimum Passing Dist for two lanes, in m	*	*	*	*	*

(General practice calls for vertical curves to be multiples of 10 meters. Calculated lengths shall be rounded up in each case.)
* Currently under revision.
(Reference NCDOT Roadway Metric Design Manual page 1-12 T-1)

SIGHT DISTANCE (ENGLISH)				
Design Speed, MPH	30	40	50	60
Stopping Sight Distance:				
Minimum (ft.)	200	275	400	525
Desirable (ft.)	200	325	475	650
Minimum K* Value for:				
Crest Curve	30	60	110	190
Sag Curve	40	60	90	120
Passing Sight Distance:				
Minimum Passing Distance for 2 lanes, in feet	1,100	1,500	1,800	2,100

(General practice calls for vertical curves to be multiples of 50 feet. Calculated lengths shall be rounded up in each case.)
(Reference NCDOT Roadway Design Manual page 1-12 T-1)

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* K is a coefficient by which the algebraic difference in grade may be multiplied to determine the length of the vertical curve which will provide the desired sight distance. Sight distance provided for stopped vehicles at intersections should be in accordance with "A Policy on Geometric Design of Highways and Streets, 1990".

4. The "Superelevation Table" shown below shows the minimum radius and the related maximum superelevation for design speeds. The maximum rate of roadway superelevation (e) for rural roads with no curb and gutter is 0.08. The maximum rate of superelevation for urban streets with curb and gutter is 0.06, with 0.04 being desirable.

SUPERELEVATION TABLE (METRIC)		
Design Speed	Maximum e*	Minimum Radius m
50 km/h	0.04	100
65	0.04	175
80	0.04	280
100	0.04	490
50	0.06	90
65	0.06	160
80	0.06	250
100	0.06	435
50	0.08	80
65	0.08	145
80	0.08	230
100	0.08	395

e = rate of roadway superelevation, meter per meter

SUPERELEVATION TABLE (ENGLISH)			
Design Speed	Maximum e*	Minimum Radius ft.	Max. Deg. of Curve
30 mph	0.04	302	19 00′
40	0.04	573	10 00′
50	0.04	955	6 00′
60	0.04	1,637	3 45′
30	0.06	273	21 00′
40	0.06	521	11 15′
50	0.06	955	6 45
60	0.06	1,432	4 15′
30	0.08	260	22 45′
40	0.08	477	12 15′
50	0.08	819	7 30′
60	0.08	1,146	4 45′

* e = rate of roadway superelevation, foot per foot
(Reference NCDOT Roadway Design Manual page 1-12 T-6 thru T-8)

D. Intersections

1. Streets shall be laid out so as to intersect as nearly as possible at right angles, and no street should intersect any other street at an angle less than sixty-five (65) degrees.

2. Property lines at intersections should be set so that the distance from the edge of pavement, of the street turnout, to the property line will be at least as great as the distance from the edge of pavement to the property line along the intersecting streets. This property line can be established as a radius or as a sight triangle. Greater offsets from the edge of pavement to the property lines will be required, if necessary, to provide sight distance for the stopped vehicle on the side street.

3. Off-set intersections are to be avoided. Intersections which cannot be aligned should be separated by a minimum length of 60 meters (200 ft) between survey center lines.

E. Cul-de-sacs

Cul-de-sacs shall not be more than 150 meters (500 ft) in length. The distance from the edge of pavement on the vehicular turn around to the right-of-way line should not be less than the distance from the edge of pavement to right-of-way line on the street approaching the turn around. Cul-de-sacs should not be used to avoid connection with an existing street or to avoid the extension of an important street.

F. Alleys

1. Alleys shall be required to serve lots used for commercial and industrial purposes except that this requirement may be waived where other definite and assured provisions are made for service access. Alleys shall not be provided in residential subdivisions unless necessitated by unusual circumstances.

2. The width of an alley shall be at least 6.0 meters (20 ft).

3. Dead end alleys shall be avoided where possible, but if unavoidable, shall be provided with adequate turn around facilities at the dead end as may be required by the Planning Board.

G. Permits For Connection To State Roads

An approved permit is required for connection to any existing state system road. This permit is required prior to any construction on the street or road. The application is

available at the office of the District Engineer of the Division of Highways.

H. Offsets To Utility Poles

Poles for overhead utilities should be located clear of roadway shoulders, preferably a minimum of at least 9.0 meters (30 ft) from the edge of pavement. On streets with curb and gutter, utility poles shall be set back a minimum distance of 1.8 meters (6 ft) from the face of curb.

I. Wheel Chair Ramps

All street curbs being constructed or reconstructed for maintenance purposes, traffic operations, repairs, correction of utilities, or altered for any reason, shall provide wheelchair ramps for the physically handicapped at intersections where both curb and gutter and sidewalks are provided and at other major points of pedestrian flow.

J. Horizontal Width on Bridge Deck

1. The clear roadway widths for new and reconstructed bridges serving 2 lane, 2 way traffic should be as follows:

   a. Shoulder section approach

      i. Under 800 ADT design year

         Minimum 8.4 meters (28 ft) width face to face of parapets, rails, or pavement width plus 3.0 meters (10 ft), whichever is greater.

      ii. 800 - 2000 ADT design year

         Minimum 10.2 meters (34 ft) width face to face of parapets, rails, or pavement width plus 3.6 meters (12 ft), whichever is greater.

      iii. Over 2000 ADT design year

         Minimum width of 12 meters (40 ft), desirable width of 13.2 meters (44 ft) width face to face of parapets or rails.

   b. Curb and gutter approach

      i. Under 800 ADT design year

         Minimum 7.2 meters (24 ft) face to face of curbs.

ii. Over 800 ADT design year

Width of approach pavement measured face to face of curbs.

Where curb and gutter sections are used on roadway approaches, curbs on bridges shall match the curbs on approaches in height, in width of face to face of curbs, and in crown drop. The distance from face of curb to face of parapet or rail shall be a minimum of 450 millimeters (1' 6"), or greater if sidewalks are required.

2. The clear roadway widths for new and reconstructed bridges having 4 or more lanes serving undivided two-way traffic should be as follows:

a. Shoulder section approach - Width of approach pavement plus width of usable shoulders on the approach left and right. (Shoulder width 2.4 m (8 ft) minimum, 3.0 m (10 ft) desirable.)

b. Curb and gutter approach - Width of approach pavement measured face to face of curbs.

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